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MANUAL

OF

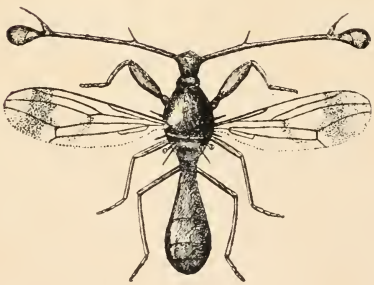
NORTH AMERICAN DIPTERA

BY

SAMUEL W. WILLISTON

THIRD EDITION

Illustrated



NEW HAVEN
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1908

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PREFACE.

Twenty-four years ago the writer began the publication, in the Bulletin of the Brooklyn Entomological Society, of a series of synoptic papers on the families and genera of North American Diptera. Previous to that time but seven of the sixty odd families had thus been rendered accessible to the American student in the works of Loew and Osten Sacken. In 1888 these synopses were revised and published, with others, in a pamphlet of 88 pages entitled 'Synopsis of the Families and Genera of North American Diptera, exclusive of the Nematocera and Muscidæ.' It contained tabular definitions of about three hundred and fifty genera, all at that time known from the United States in the families treated. In the succeeding eight years the writer's acquaintance, especially with the southern forms, had been so widened that he attempted a similar review of all the North and Middle American genera, aided by Professor Aldrich in the Dolichopodidæ and Mr. Snow in the Ortalidæ. Regretfully the very large and almost chaotic families Dexiidæ and Tachinidæ were not included. Eight hundred and twenty-six genera were defined in this 'second edition' more or less accurately, very nearly all of which, save those of the Dolichopodidæ, had been studied by the writer in its preparation. The continued use of this work, both in America and abroad, has been very gratifying to the author, a use that has made him the more desirous that a better and more complete edition should be prepared, one that would be of greater service to the amateur, whose interests have been paramount. For such an edition the present time seemed opportune, since the recently published catalogue of the Diptera of North

America, by Professor Aldrich, a very meritorious work, has lessened materially the labor of its preparation, and must add to its usefulness. It was with some misgivings, however, that the author undertook the no inconsiderable task, since his studies for some years past have been almost wholly in a widely different field from that of entomology—vertebrate paleontology, a subject which, indeed, has absorbed the larger share of his attention for the past thirty years.

But, he would not have undertaken the task, save upon the kind assurance of assistance and contributions by several of the leading students of diptera in the United States. The chief progress during the last twelve years has been in comparatively few families, the most of which had been but indifferently well studied at the time of the publication of the second edition; a progress in large part due to the work of the present contributors.

Professor C. F. Adams has kindly aided in a large part of the work, especially the Cyclorrhapha, though the writer assumes all responsibility for changes and additions not directly accredited to the several contributors. Professor Adams has also furnished the tables for the very difficult families Dexiidæ and Tachinidæ, omitted in the previous edition. As in the former edition, the characters and table of the Dolichopodidæ are wholly the work of Professor Aldrich; he has also generously assisted in other ways, and it need not be said that, without the aid of his Catalogue, the labor of revision would have been greater, and the results less satisfactory. Mr. C. T. Brues, who has given so much critical attention to the singular family Phoridæ, has furnished the characters and table of that family; one needs to compare his table with that of the former edition to see how much has been done in that group. Professor James Hine has revised the characters and table of the Tabanidæ. Professor

O. A. Johannsen has furnished a new table of the Chironomidæ. Professor V. L. Kellogg has done the same for the Blepharoceridæ, and has revised the family characters. Professor A. L. Melander has treated the Empididæ anew; and Professor C. H. T. Townsend has generously criticised the figures of the Dexiidæ and Tachinidæ, and has furnished important notes on many of the genera. To all these gentlemen the author tenders his sincerest thanks, not only on his own part, but also on the part of those who will have occasion to use the work.

At the outset it was not contemplated to give many illustrations, chiefly such as would be explanatory of the more important characters. In the end more than six hundred genera have been defined more or less fully and decisively by nearly one thousand figures. Of these figures all those of the Dolichopodidæ and the first plate of those of the Tachinidæ were furnished by Professor Aldrich. Mr. Brues has furnished the figures of the Phoridæ, Professor Hine those of the Tabanidæ, and Professor Melander most of those illustrating the Empididæ. Professor Washburn kindly gave permission to use electrotypes of twenty-three figures prepared for his or the late Professor Lugger's reports on Minnesota Diptera. To Professor Kellogg and Henry Holt & Co. the writer is indebted for eight electrotypes of figures in Professor Kellogg's American Insects; and to Professor J. B. Smith his thanks are due for six figures of the Culicidæ, originally prepared for his Report on the Mosquitoes of New Jersey. A few other figures have been copied from reliable sources, where specimens were not easily accessible, and are likewise credited in each case to its author. All the remainder, whether drawings or photographs, more than eight hundred in number, have been made by the writer from specimens—a task which has involved many months of labor, but which could not, in most cases, have been safely entrusted to a professional draftsman.

To the authorities of the National Museum and Mr. D. W. Coquillett, the writer is indebted for the communication of specimens of fourteen genera for purposes of illustration. Finally he has to express his hearty thanks to his friend and former colleague, Dr. F. H. Snow of the University of Kansas, for the free permission to make use of whatever specimens were needed in the rich collections of that University—collections which include nearly all the types of diptera from the United States described by Townsend, Snow, Adams and the writer.

Since the preparation of the present edition was begun has occurred the death of one whose name will ever be honorably associated with American Dipterology, Dr. C. R. Osten Sacken. The author can not forbear placing on record here an earnest tribute of friendship and admiration for the man, and unqualified appreciation of his work as an entomologist. His constant encouragement and kindly criticism during a correspondence of more than twenty years have made this book, whatever be its merits, possible; and the author only hopes that it may be found not unworthy of association with his work. It is with pain, also, that the author here records the death, in early years, of his friend and student the late Mr. W. A. Snow, who assisted in the preparation of the Ortalidæ of the former edition.

About twelve hundred genera are defined in the present edition, with the exception of a few doubtful forms, all those known from North and Central America and the West Indies. That the definitions are wholly without error is inconceivable. Whatever revision the book may receive in the future must be left to others, and, in taking final leave of it after these twenty-four years, the writer will be pardoned in repeating the words of a master, one whose works have served as models for this, Rudolph Schiner:

'Und so uebergebe ich denn diese meine Arbeit der Oeffentlichkeit mit dem Wunsche, dass sie billigen Anforderungen entsprechen moege und mit dem Beifuegen, dass ich dem Urtheile unparteiischen Leser mit voller Beruhigung entgegensehe, da ich bewusst bin, bei Loesung meiner Aufgabe mit allem Ernste und der groessten Gewissenhaftigkeit vogegangen zu sein.'

SAMUEL W. WILLISTON.

UNIVERSITY OF CHICAGO, June, 1908.

CONTENTS.

INTRODUCTION 9
Structure and habits of flies 16
Morphology 20
Head 20
Mouth-parts 24
Antennæ 27
Thorax 31
Legs 34
Abdomen 36
Wings 37
Vestiture 43
Chætotaxy 45
Internal anatomy 49
Classification of diptera 51
Collection and preservation of flies 62

GROUP CHARACTERS AND SYNOPTIC TABLE OF THE FAMILIES OF DIPTERA 65

FAMILY CHARACTERS AND SYNOPTIC TABLES OF GENERA

I Tipulidæ 81
II Psychodidæ 92
III Dixidæ 94
IV Culicidæ 96
V Chironomidæ 110
VI Cecidomyidæ 117
VII Mycetophilidæ 131
VIII Bibionidæ 140
IX Simuliidæ 144
X Blepharoceridæ 148
XI Orphnephilidæ 153
XII Rhyphidæ 155
XIII Leptidæ 157
XIV Stratiomyidæ 164
XV Acanthomeridæ 173
XVI Tabanidæ 176
XVII Cyrtidæ 182
XVIII Nemestrinidæ 186
XIX Apioceridæ 188

XX	Mydaidæ	190
XXI	Asilidæ	192
XXII	Therevidæ	205
XXIII	Scenopinidæ	208
XXIV	Bombyliidæ	210
XXV	Empididæ	218
XXVI	Dolichopodidæ	228
XXVII	Phoridæ	336
XXVIII	Lonchopteridæ	240
XXIX	Platypezidæ	241
XXX	Pipunculidæ	244
XXXI	Syrphidæ	246
XXXII	Conopidæ	261
XXXIII	Tanypezidæ	264
XXXIX	Micropezidæ	264
XXXV	Psilidæ	267
XXXVI	Sepsidæ	269
XXXVII	Ortalididæ	271
XXXVIII	Rhopalomeridæ	280
XXXIX	Trypetidæ	282
XL	Sapromyzidæ	288
XLI	Agromyzidæ	291
XLII	Geomyzidæ	297
XLIII	Drosophilidæ	299
XLIV	Ephydridæ	303
XLV	Oscinidæ	310
XLVI	Diopsidæ	314
XLVII	Borboridæ	315
XLVIII	Phycodromidæ	317
XLIX	Heteroneuridæ	318
L	Sciomyzidæ	321
LI	Helomyzidæ	324
LII	Cordyluridæ	327
LIII	Anthomyidæ	331
LIV	Muscidæ	337
LV	Œstridæ	344
LVI	Sarcophagidæ	348
LVII	Dexiidæ	352
LVIII	Tachinidæ	358
LIX	Hippoboscidæ	382
LX	Streblidæ	384
LXI	Nycteribiidæ	386

APPENDIX 387

INDEX 391

North American Diptera.

INTRODUCTION.

The order of two-winged insects known as flies or Diptera includes more than forty thousand known species from different regions of the world. Since many of the species are small, or even minute, and inconspicuous, and since the order as a whole has not received the attention from collectors and students of entomology that other and more attractive groups have, it is very certain that many more await discovery. A very reasonable estimate would place the entire number of species of flies at present in existence at more than eighty thousand. From North America the recent catalogue of Aldrich gives a list of about eight thousand species, distributed in more than a thousand genera. The subject is a wide one and replete with interest.

To the student beginning the study of this interesting order of insects a few words of advice or caution may not be superfluous. The present work can make no pretensions to completeness in the characterization of genera, at least in the majority of cases; that would require a work many times larger than is the present one, and is practically impossible at the present time. One must not, therefore, depend entirely upon tables and figures in the absence of other information and other assistance, especially when he knows but few forms. If he does not immediately succeed in securely locating his specimens

he should not too hastily conclude that they are 'new'. Until he has acquired a considerable acquaintance with different families, the work of classification may at times be tedious, but by perseverance he can not fail to overcome whatever obstacles families and genera may present. He will be very much aided at the beginning by having a tolerably large collection at his command with which to make comparisons. Difficulties to the inexperienced will often disappear with positive evidence before him, when negative characters would be doubtful. With each genus in a family positively determined, the difficulties and uncertainties of others will gradually disappear. Better still if he has numerous species reliably named with which to begin his studies. The present writer in his entomological career had few if any species or genera determined for him by others, and he well appreciates how wasteful of energies was such a method, at the time unavoidable. For full generic descriptions of many, perhaps the larger part, of the North American genera, the student will find a most valuable aid in Schiner's Fauna Austriaca, a work of which too much can not be said in praise. The descriptions are remarkable for their fullness, accuracy and simplicity, and, although the work is forty years old, it has lost but little of its value.

To determine his species the student will need access to a large number of books and papers, lists of which to the present time will be found in Aldrich's admirable and indispensable Catalogue of North American Diptera, published by the Smithsonian Institution. One must not, however, let the formidable lists frighten him. He will not need them all to begin with, nor even the larger part of them, and the earnest student can always be assured of the sympathy and assistance of his fellow workers. His earlier determinations, and those of the student who is concerned chiefly in obtaining a broad general

knowledge of the taxonomy of the diptera, may be confined, for the most part, to those groups which have been monographed, with full descriptions of genera and species, and, if possible with numerous illustrations. References to the more important papers of each family will be found in Aldrich's catalogue.

Long before the student has reached the dignity of 'independent research', he will have learned who the masters of dipterology are; who have shown the greatest acumen in the discernment and use of classificatory characters. It will not be invidious to distinguish above all others Schiner, Loew and Osten Sacken as writers who can not be too faithfully studied, too closely followed. Not that they are infallible; none are. Indeed an error of a master is often more instructive than the masterpiece of a dullard. One must learn the values of characters in classification before he can be successful in instructing others, or in making his discoveries known. And this knowledge can only be acquired by long and faithful study of living things and due reflection thereon. The narrow systematic specialist is looked upon somewhat askance by modern biologists, and rightfully too, but I have no hesitation in saying, and it is the experience of many years of study in different branches of natural history, that the right kind of systematic work calls for the highest scientific powers of the student. I am aware that some narrow specialists in other departments of science will take exception to this statement, but I believe it and say it for the encouragement of those who may be dissuaded from the earnest study of such creatures by the flippant remark of the shallow minded. But a mere collector of specimens, one who finds enjoyment in getting the largest number and arranging them in serial form in his cabinet is not necessarily a scientific student, though he may have a very pleasant and useful pastime; his la-

bors are scarcely more important than those of the microtomist who cuts up frogs' eggs and makes pictures of them. There are no principles too deep, no speculations too lofty to find application in such creatures as flies, the too often proletarians of the professional entomologist even.

Most emphatically I would impress upon all students of dipterology who undertake the subject seriously, that the greatest need of modern entomology is monographic work. Nearly every family awaits the conscientious monographer, and such work is that which lasts longest and acquires most renown. The problems of distribution, of relationship, of origin, of the effects of environments, or the meaning and value of characters, can be satisfactorily solved by critical monographic studies only. The description of 'new species' as mere membra disjecta of faunas, is scarcely worth the energies of the earnest and careful student, certainly not as a life vocation, and none else has any business to write at all. It too easily degenerates into a mere roll-calling, a catalogue of the permutations of a few characters, increasing the difficulties for real students who come afterward. The name that an insect is known by is of trivial importance, and no one cares who described it, unless he did it poorly. It will be a fortunate thing when the search for 'new species' and the interminably haphazard making of 'new genera' is done.

Even a cursory glance at some of the tables further on will convince the intelligent student that the real meaning of many of the classificatory characters is yet imperfectly comprehended. But little attention has been paid to homoplasy or 'convergent evolution', and as all true classification must depend upon the proper use of genetic characters, it is apparent that future revisions may materially modify our present conceptions of relationships

in many cases. I can offer no better example of this disregard for phylogenetic and convergent evolution than is shown in the proposed scheme of classification of the Cecidomyidæ on later pages. The structure and use of the organs of orientation,—the antennæ and palpi especially, the further comparative study of the ocelli and eyes, the reasons for the evolution of the wing venation in apparently different systems, the causes of the variations in the patterns of coloration, the meaning more fully of the different kinds of vestiture, etc., etc., all need much more attention than has been given them by the systematist, and it is he who is best qualified to solve such problems.

One of the first questions that a novice in classification asks is: What is a species, genus, family? The taxonomist's answer to the first of these queries is easy: A species is a form of life with all its fertile variants. A mastiff and a grayhound are not distinct species of dogs, because there exist all possible variations between the two types, though both have bred true to themselves for more than three thousand years. But a dog and a fox are distinct species because there exist no varieties connecting the two. If no two specimens in a given form of fly have precisely the same relative lengths of the antennal joints, then the relative lengths of these organs is not a specific character in that form. If, however, all the specimens occurring in Massachusetts have a definite relative length for each joint while those in Kansas have another, the first impression is that they belong to distinct species. If further discovery proves that, in crossing the country between Massachusetts and Kansas, the lengths gradually vary from one to the other, then we must consider the eastern and western specimens as merely racial varieties of a single species. The systematist is never troubled as to what a species is, if he has all the material he wants.

The answer to the second query, What is a genus? is, however, a very different matter. Ordinarily we might apply the same criterion, that groups of species gradually blending together should not be separated into two or more genera. But this will not suffice, since, because of the actual presence of the connecting links, the extremes may vary enormously, far more than in many cases where the connecting links have disappeared, leaving the extremes isolated into easily distinguishable genera. Both convenience and the demands of relationships require here that such groups be broken up, though it may and often does entail the result that such genera may be ultimately distinguishable in their most allied species by only trivial characters. But the temptation offered here, especially to the narrow, perspectiveless specialist, is to use those same boundary characters, or their equivalents, as generic characters through the whole family, and the result is an almost innumerable number of proposed divisions. As nearly every species of flies has some plastic or structural distinguishing character, it is very evident that we might ultimately reach the absurd result of making species and genera coterminous. Between this extreme and the other, the grouping of large numbers of species into genera, all of which can be distinguished by decisive, if not important, structural characteristics, there must be a happy mean. This mean, however, must depend more or less upon the opinions of those best qualified to interpret them. In other words I am tempted to define a genus as being merely the *personal opinion of its proposer*. By an excessive 'splitting' of genera, broader relationships are lost sight of, and the tendency is inevitable to restore those evidences by the invention of new group terms to express them. Perhaps no better examples of these tendencies are observable than in the more recently proposed classification of the mosquitoes. For

many decades systematists were satisfied to distribute the known mosquitoes in a relatively small number of genera, genera which could be defined by characters equivalent to those used in the allied families of diptera. With the great impetus given to the study of these insects by the discovery of their agency in the spread of disease, the genera have been broken up into many new divisions, until seventy or eighty are now recognized by some students of the family. In the dearth of striking characters, those of extreme minuteness have been resorted to, such as the relative lengths and widths of the scales and their distribution on the body; and even colorational characters have been called in aid. The obliteration of relationships thus brought about has rendered the erection of numerous subfamilies necessary, and it is even seriously proposed to elevate the previously accepted subfamilies to family rank, and the family Culicidæ to a superfamily! And I doubt not that some zealous confrere may yet seriously propose to consider the old family Culicidæ as a suborder! Possibly also, it may be necessary some time in the future to have a quantitative chemical analysis of a mosquito before deciding to which genus it may belong. Now it is very apparent that the importance of the mosquitoes in man's economy can have no value in classification; that, if the happiness and welfare of every living being were dependent upon the mosquitoes it could not affect the classification of the family one whit; but something of the sort seems to have resulted.

I will admit that excessive 'splitting' of genera often brings to light and tests many differential characters which otherwise might long remain obscure. Nevertheless, convenience is an important end of classification, as well as the expression of relationships. In days gone by the profuse maker of genera was ridiculed and the results of his labors were largely ignored; but I fear even Des-

voidy's shade would turn pale with envy in the contemplation of some of the proposed genera of the modern culicidologists.

STRUCTURE OF FLIES.

The word diptera, by which the two-winged flies are known, signifies two wings, the chief characteristic of the adult insects. All diptera, if they have any wings, have but a single pair. The hind pair of other insects is really represented by a small organ on either side, back of the true wings, consisting of a short, slender stem, terminating in a knob. The precise function of these 'halteres' or 'balancers', as they are called, if they have any, is not known; that they have a secondarily acquired use is probable, since they are always in vibration during flight; an orienting or balancing function has been ascribed to them. The halteres are very characteristic of the order, always present in the winged forms, and usually present even in those in which the true wings are aborted or functionless, though rarely they are entirely absent. Not all flies are winged, as has been already intimated; rarely, among both the more generalized and the more specialized groups they are imperfectly developed or wholly wanting. Their absence is not of very great classificatory importance, never more than generic, and sometimes doubtfully that. Sometimes the male has wings and the female is wingless; but the number of wingless forms of any kind is very small.

In size as well as in shape, flies vary not a little. As compared with the lepidoptera, orthoptera, neuroptera, and even the hemiptera, flies are relatively small insects. The largest specimen of a fly of which I have knowledge is that figured herewith natural size, pertaining to an indeterminable species of *Mydas* from South America. The length of this specimen from the tip of the antennæ

Fig. 1. *Mydas*, species indet. Life size. (Brazil.)

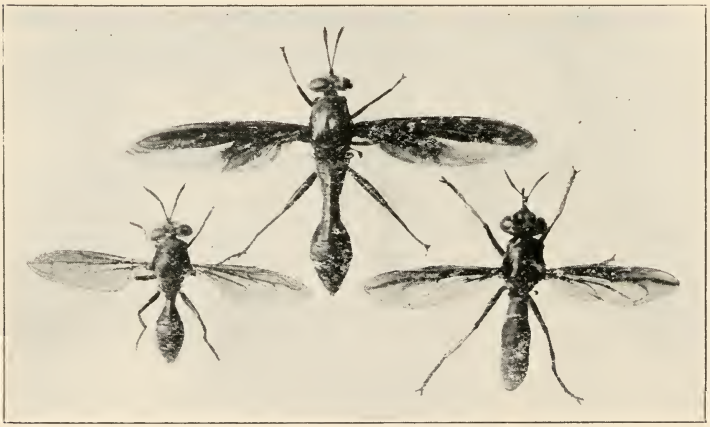
Fig. 2. *Acanthomera*, species indet. Life size. (Venezuela.)

to the extremity of the abdomen, is sixty-seven millimeters, or, omitting the antennæ, fifty-two millimeters; the expanse of wings one hundred and seventeen millimeters, or a little more than four and one-half inches. The smallest dipteron that I have ever observed in the examination of many thousand specimens and five or six thousand species, is that of a cecidomyid measuring a trifle less than one half millimeter, also omitting the antennæ. In other words, the *Mydas* is more than one million times the size of the cecidomyid. Possibly there are still greater discrepancies between the largest and smallest specimens of the order, but in all probability not much. The largest insect known is one allied to the dragon flies, an extinct Devonian species which measured about fifteen inches in length. Assuming that the bodily proportions of the largest and smallest hexapods are not unlike, the extremes of size or weight are more than four hundred millions apart. In no single family of diptera are the differences in size anywhere nearly so great as those between the mydaid and cecidomyid. Seldom do the differences in linear measurements in any one family exceed ten fold. Among other families of diptera the tipulids, asilids, and especially the pantophthalmids, often furnish examples of large size, while the tabanids, syrphids and cyrtids have not a few forms of considerable size. The largest of all the Cyclorrhapha will be found among the Calypteræ, while the Acalypteræ are rarely much above the average in size, and many are small, or very small.

Giantism in any group of animal life is a specialization, and is, in general, an indication of approaching decadence; enduringly small races are never the descendants of giants, for decrease in size means lessened vitality and incipient extinction. No strong or dominant group of flies, like the Tachinidæ, Dolichopodidæ, Syrphidæ, or

Bombyliidæ, has ever had in the past a larger average bodily size than is found among their living representatives. On the other hand, those families composed today chiefly of large forms are ones already past their prime. These conclusions seem established for the larger forms of life, and I believe that they are in the main also applicable to insects.

Many curious resemblances of external form are observable among diptera belonging to widely different families and of remote relationships. Some of these, perhaps many, have a protective value, in flies of like habits; or they may have been the results of like environmental conditions.



Ceria. Ceriomydas. Conops.

Fig. 3. Examples of mimetic resemblances in flies. *Ceria* (Syrphidæ); *Ceriomydas* (Mydaidæ); *Conops* (Conopidæ). Slightly reduced.

In figure 3 are given photographs of three wasp-like flies of very different families and of considerable size, all of them associated in the same fauna, and curiously

resembling each other; several others equally striking might have been associated in the same group.

The habits of flies are very diverse. Many are properly spoken of as flower flies—that is, insects whose subsistence, for the most part or entirely, is obtained from the honey or pollen of flowers, and the sweetened sap of plants. Among these are many which are swift in flight, spending most of their time during sunny hours upon the wing or resting lightly upon leaves and flowers; they all love the warmest sunshine. Some mature flies feed upon ordure or decaying material of whatever nature it may be. Many others, including whole families like the Asilidæ, Dolichopodidæ and Empididæ, find their subsistence in the juices of other insects, and are often predaceous in the highest degree. Others, like the female mosquitoes, blackflies and horseflies, are bloodsucking in habit, though not exclusively so, and are often very annoying to man and other warm-blooded animals. The whole group of Pupipara, with the exception of the Braulidæ, are of this kind, living parasitically upon and sucking the blood from mammals and birds. In the previous edition of this work I expressed the opinion that, upon the whole, the order of diptera is beneficial to man's economy, since so many of its members, whether in the larval or adult conditions, are either useful scavengers, destroying that which otherwise might cause distress, or prey upon other and injurious insects. Since the publication of that edition, however, the many marvelous and important discoveries of the parasitic habits of certain very small protozoans which find their intermediary hosts in certain flies, by whose instrumentality they are transmitted to man and some of his most valued domestic animals, will require the complete reversal of that opinion. Yellow fever, malaria, and filariasis, transmitted in the saliva of mosquitoes, and the fatal 'sleeping sickness'

(trypanosomiasis), likewise resulting from the predatory bites of the tsetze fly, are among the most virulent or widespread diseases of mankind. Perhaps we may justly say that the order, so far as man is concerned, is the most pestilential of all animal life.

In the larval condition the habits of flies are even more diverse than are those of the adult insects. Brief references to the larval habits will be found in the discussion of the families. Suffice it here to say that the larvæ or 'maggots' of diptera are, for the most part, vegetable feeders, but not a few feed upon living or decaying animal matter; and many are parasitic within the bodies of other insects, whether larvæ or adults, snails, reptiles, birds and mammals, and possibly also amphibians and fishes.

MORPHOLOGY OF DIPTERA.

In the following pages I endeavor to give such definitions and descriptions of the mature insect as will enable the student to understand and appreciate, not only the present work, but all other systematic works upon diptera. I have not thought it desirable to consider at length many interesting subjects connected with them, such as their internal anatomy, embryology, larval habits, etc., as being rather apart from the chief object of the work—an introduction or aid to the study of systematic dipterology.

HEAD.

The head in diptera is very variable in shape, reaching its most remarkable development in the Diopsidæ and Nycteribiidæ. It is frequently more or less spherical, but usually the posterior surface or occiput is flattened or concave, giving a more hemispherical appearance. The face is rarely produced into an elongated rostrum or snout, and the front part may be produced into a conical prominence. Its relative size is also variable, some-

times distinctly wider than the thorax, at other times small. In the Nycteribiidæ it may be folded back into a groove on the dorsum of the thorax, but with these exceptions, it is always attached to the thorax by a freely movable neck. The taxonomic characters furnished by the head are second only in importance to those of the wings.

Eyes. The large compound eyes are present in all diptera, save some Pupipara. In the majority of males, especially of the Orthorrhapha, they are contiguous on the upper side of the head, between the insertion of the antennæ and the hind margin, for a longer or shorter distance; insects having such contiguous eyes are called holoptic (Osten Sacken). In many males, however (all the Acalypteræ and several families of the Orthorrhapha, as well as numerous genera of other families), and in all females, with but few exceptions (certain Cyrtidæ, Orphephilidæ, Blepharoceridæ, Bombylidæ, Platypezidæ, etc.), the eyes are separated more or less broadly by the front: such insects are called dichoptic (Williston). Rarely the eyes may be contiguous below the antennæ, or both above and below, as in certain cyrtids, etc. In not a few flies, especially those of the aerial, bristleless kinds, the upper facets of the eyes are larger and more conspicuous than the lower ones, sometimes separated by a distinct line, or even entirely divided. This peculiarity is rarely seen in the female or even in the dichoptic male, though the dichoptic Asilidæ may have the anterior facets somewhat enlarged in both sexes. Those flies having such enlarged facets usually have the eyes in life brilliantly and beautifully colored with green and purple markings—markings often characteristic of the various species, and the general pattern even of the genera. Unfortunately such markings are obliterated by dessica-

tion, though they may be somewhat revived temporarily by the aid of moisture.

Most flies have the eyes bare, or pubescent only when seen under high magnification. Not rarely, however, the whole or part of the eyes is covered with erect short pile, a character which usually, perhaps always, finds its greatest development in the male sex. The pubescence or pilosity may be sparse or dense, short or long, and is usually, though not always, of generic importance.

Ocelli. On the upper part of the front in the middle, between or a little back of the compound eyes, there are three simple, small eye lenses, present in most diptera, and called ocelli. They are by no means constant among all the genera of some families, or even among all the species of some genera. They are usually situated in the form of a triangle with the apex in front; sometimes they are located in a nearly straight line transversely; or, the middle one may be rarely absent, and the other two situated, one on each side, near the compound eyes.

Front. The space between the eyes in all dichoptic flies, limited by the upper margin of the head and the line drawn through the root of the antennæ, is called the front. It may be wide or narrow, excavated or convex, etc.

Vertex. The uppermost part of the front, near the margin of the occiput, which is here called the *vertical margin.*

Vertical triangle. The triangle at the upper part of the head, between the eyes in holoptic flies. It bears the ocelli, which may be situated on a triangle indicated by grooves or depressions or colorations, called the *ocellar triangle.*

Frontal triangle. In holoptic flies, the triangle between the eyes and the root of the antennæ, the apex of which is above. Sometimes the term is applied to a triangle indicated by color or depression in the dichoptic front.

Ptilinum. In the Cyclorrhapha an inflatable organ ca-

pable of being thrust out through the frontal suture just above the root of the antennæ, and which is used by the imago in springing off the cap to the puparium when about to extricate itself.

Frontal lunule. An oval or crescentic space just above the root of the antennæ in cyclorrhaphous flies, bounded by the frontal suture.

Epistoma or *Peristoma.* The oral margin and an indefinite space immediately contiguous thereto; not often now used.

Antennal fovea or *groove.* A groove or grooves in the middle of the face, as though for the lodgment of the antennæ, bounded on the sides by the *facial ridges.*

Cheeks or *'jowls'.* The space back of the face and below the eyes.

Orbits. The space immediately contiguous to the eyes, sometimes indicated by structural characters, at other times indefinite. It is called facial, frontal, etc., from the position.

Clypeus. A part of the mouth structure, often visible below the margin of the mouth in front as a more or less visor-shaped piece.

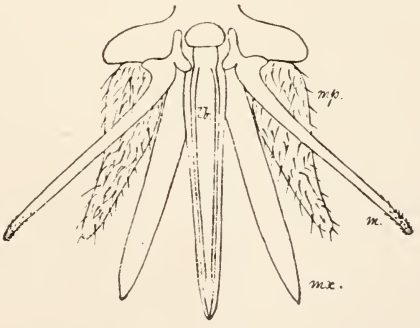


Fig. 4. Mouthparts of female *Tabanus.* After Washburn. *mp*, maxillary palpus; *m*, mandible; *mx*, maxilla; *lb*, labium.

MOUTH-PARTS.

The mouth-parts of diptera are wholly suctorial. They differ not a little in different flies, as might be supposed from their diverse habits. In some they are adapted for piercing animal or vegetable substances, and are, in consequence, firmer and more slender; in others, and by far the greater number, they are short and soft, with a thickened extremity used for the attrition of small particles of solid substances. Grains of pollen have been observed in the digestive organs of the Syrphidæ and other flower flies, but, as a rule, fluids only serve as food. Many have the proboscis wholly retractile into the oral cavity, and furnished with one or even two hinges, by which when at rest it may be folded up. In others the proboscis is not retractile, and projects either in front, or downward or backward, beneath the body. While it is usually short, it may be much longer than the body. Finally, a few species have the mouth-parts vestigial and take no nourishment in the adult state.

The more commonly accepted homologies of the mouth-parts are as follows: labium, maxillæ, maxillary palpi, mandibles, hypopharynx, and labrum or labrum-epipharynx. The labial palpi are thought to be wholly wanting,* or represented by the labella. The labium is always present, more or less fleshy and provided with muscles. It is grooved or channeled on the upper side to receive the other parts, with the exception of the maxillary palpi, which are free. This sheath is often nearly complete, the thin margins touching each other above. At its tip are the pair of joints of variable size called the 'lips' or labella. The maxilla and mandibles are sometimes

*This has very recently been contested by Wesche, who asserts that either the labial or maxillary palpi may be present and functional; but no cases are known of both pairs being functionally present. I am inclined to be skeptical.

absent, the mandibles most frequently; when present they are always slender and firm. The hypopharynx is unpaired and slender, grooved on the upper side and sometimes converted into a nearly complete tube. The labrum, also unpaired, is usually elongate and grooved on the under side, forming by apposition with the hypopharynx a complete tube. The mandibles are frequently absent; in fact I do not know of their occurrence in any flies with a simple third antennal joint, and they may be absent in the male when present in the female, as in the Tabanidæ. They are always piercing organs, thin, firm, chitinous and usually slender. The two maxillæ, likewise piercing organs, find their highest development in such predaceous flies as the Asilidæ. Like the mandibles they are chitinous and slender. In some they are more or less flattened, and may have curiously shaped projections at the tip; usually they are bristle-like. They lie with the maxillæ within the sheath of the labium, at either side of the labrum and hypopharynx. In some cases the labrum is short, and serves only as a cover for the proximal part of the hypopharynx, but usually it is as long as or longer than the hypopharynx and has a simple groove on the under side. The hypopharynx is always present in flies in which the mouth-parts are functional. It is, more often, a slender, firm organ, grooved upon the upper side, which by apposition with the labrum forms a distinct tube. In some, however, it may form an almost complete tube in itself.

Leaving out of account the degraded, but highly specialized Pupipara, the labium is always a sheath for all the other organs except the palpi, but is separable at the will of the insect. It is not used in piercing; it is either bent backward in the middle, as in the mosquito, or the piercing parts are thrust out at the extremity as in most of the predaceous flies. To facilitate this protrusion of

the piercing parts, the proximal portion is more or less membranous and retractile; or, the inner organs may be capable of elongation, being coiled up in some cases, as in *Pangonia*, within the pharyngeal cavity. The pair of organs at the extremity, the lips or labella, are very variable in shape, position and function. In the mosquito, for instance, they serve merely as a pair of fingers to guide the piercing parts. In many of the flower-flies with long proboscis, they are small, oval, divaricable organs, that seem to be chiefly sense organs, as they are usually provided with hairs inserted in small, semi-translucent spots on the outer sides and margins. In the greater number of flies, however, the labella are of considerable size, and are provided with radiating ridges on the inner, opposable sides. These pseudotracheæ, as they are called, serve as means of attrition, by which the insects rub off particles of food from firm substances. Sometimes the labella are long and slender and folded back under the labium when at rest. In the Asilidæ and some others, they are rigid and horny.

Perhaps the most important of all the mouth-parts, from the systematic stand point, are the maxillary palpi. They are inserted at the inferior basal part of the proboscis, on a thin plate which bears the maxillæ, and are always extricated. Their study has been much neglected, and doubtless thorough comparative researches will reveal not a few characters of value in classification. They are variously described as being composed of from one to five joints.* There are never more than four articulated joints, the basal joint being merely a process of the plate bearing the maxillæ. The tendency in diptera is toward their entire loss, and in the more highly specialized families there is never more than one joint. They

*Theobald says some Culicidæ have six joints, but his statement needs confirmation.

may be reduced to the merest vestiges even in flies which are more or less predaceous in habit and which have the mouth-parts, with the exception of the mandibles, otherwise well developed; they may indeed be absent or present in otherwise closely related genera of flies. They are seldom much elongated, save among some of the Nemocera.

ANTENNÆ.

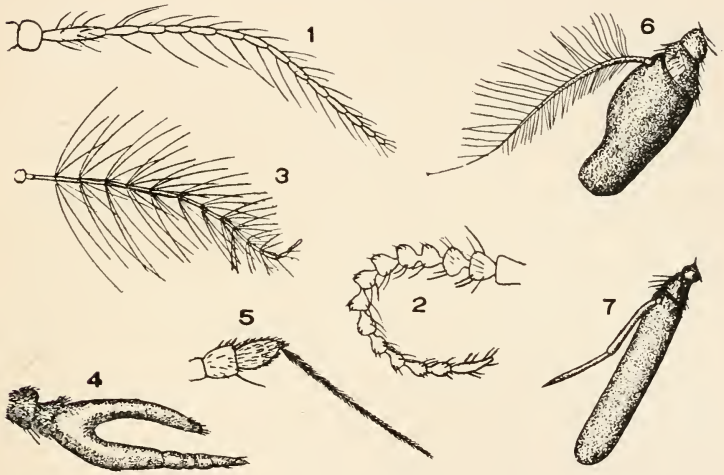


Fig. 5. Antennæ. 1, Tipulidæ (*Polymera*, female); 2, Tipulidæ (*Rhipidia*, male); 3, Culicidæ (*Aedes*, male); 4, Tabanidæ (*Stibasoma*); 5, Empididæ (*Drapetis*); 6, Syrphidæ (*Volucella*); 7, Tachinidæ (*Gonia*).

No other organs furnish so many or so important characters in the classification of Diptera as do the antennæ, or feelers as they are sometimes called. The number, shape and arrangement of the joints or segments offer not only the best of specific characters in nearly all cases, but also not rarely generic, family and even subordinal characters. Only in very exceptional instances is the number less than three, and it is probable that, even

in those, there is only a partial atrophy of the basal joint. Some Cecidomyidæ and Leptidæ *(Rhachicerus)* have as many as twenty-eight distinct joints, and it has been said there are as many as thirty-nine in some Cecidomyidæ *(Cerodozia?)*, but I can find no certain evidence supporting such a statement. Through all the Cyclorrhapha the number three, or very rarely less, is constant. In the nematocerous Orthorrhapha the number is usually from eight to sixteen, though in rare cases there may be as few as six. In such antennæ the first two joints are called the *scape*, and they are always more or less differentiated from the remaining segments which compose the *flagellum*. When the antennæ are long, or more or less filiform, the joints of the flagellum often bear whorls or verticils of hairs, especially in the males, and these hairs are sometimes of very peculiar structure, sometimes looped; in such antennæ, also, the joints may have a long and abundant plumosity.

The scape in all flies usually bears bristles or bristle-like hairs; the joints of the flagellum seldom. Upon the structure of the antennæ alone, however, it is difficult, if not impossible, to distinguish any of the larger groups of diptera, since those with long and multiarticulate antennæ merge very gradually into forms with shorter antennæ and fewer joints. Or, the separate joints of the flagellum may be fused so closely as to be distinguishable with difficulty, so that the third joint, or the basal part of the flagellum, may appear to be of a simple, undifferentiated structure, though upon closer examination found to be composed of distinct segments or annuli; in such cases the term *complex* is applied to the apparent joint. This peculiar structure will be readily understood by the examination of the antennæ of a common horsefly (fig. 5, 4), where the enlarged third joint is observed to be composed of a large basal piece and a terminal portion

of four closely united segments. By the comparison of a horsefly's antennæ with that of a *Bibio* and that of a mosquito it will be easily understood that the complex third joint is merely the closer fusion of the real joints of the flagellum, though I know of no instance of a complex joint having more than eight segments. Nor is the horsefly's so-called third antennal joint homologous with that of the housefly, but rather with the joint and the 'arista' combined. Either the complex or the simple third joint may terminate in a more or less slender, and more or less freely differentiated portion called the *style*, or in a bristle-like, elongated portion, called an *arista*. It is very evident, however, that the style or arista represents merely attenuated distal joints of the flagellum, since a close examination of them will invariably, or almost invariably, disclose from two to five segments (fig. 5, 7), though some may be very small or almost completely atrophied. The arista therefore as might be supposed, is not sharply distinguishable from a slender style; indeed the arista always, or almost always, has its basal portion thickened more or less, in some cases so much so as to form a real though short style provided with a long bristly extremity; and the style is often provided with a short bristly end. An examination of the antennæ of the Leptidæ and Stratiomyidæ, figured further on, will make these statements clear. The arista or style is of course not at all apparent in the Nemocera, since the antennal structure is here generalized, and it may be entirely wanting among the Brachycera, either because the distal flagellar joints have not become at all differentiated, as may be observed in *Xylophagus* of the Leptidæ, or because there has been an actual atrophy of the distal part of the antennæ; but the cases are rare where some of the flagellar joints beyond the basal one are not observable in flies, albeit very rudimentary. Whenever the style or

arista is composed of numerous segments, the basal piece of the complex third joint has necessarily fewer segments, since both together never have more than eight. The style, as the term is usually applied, is always terminal; while the arista may be either terminal or dorsal, usually the latter, and it may even be inserted close to the base of the third joint. It is also apparent here, and this is the rule among the Cyclorrhapha, that the basal position is in reality due to the greater development of the under side of the joint, by which the width has greatly exceeded the length. The style is only rarely present in the Cyclorrhapha (*Ceria*, *Conops*), and in but few known instances is the arista aborted in this suborder.

Fig. 6. *Talarocera nigripennis*, head of male from in front, much enlarged.

The first two antennal joints, that is the scape, are, as has been said, usually provided with hairs or bristles,

but they rarely take on an extraordinary development. One or the other or both may be greatly elongated (see fig. 19, Bombyliidæ), or one or the other may be greatly swollen (see Therevidæ). The third joint, however, has in some cases assumed most marvelous shapes, as among the Stratiomyidæ (*Neochauna*), or Tachinidæ (*Talarocera*, figs. 6, 7, *Schizotachina*, *Dichocera*, etc.)

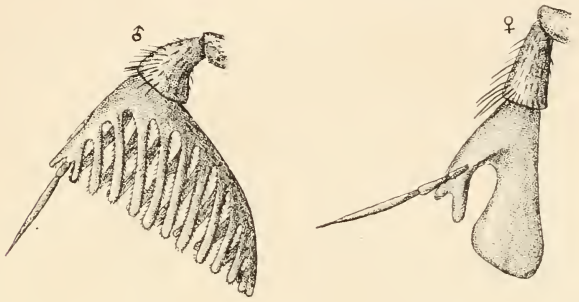


Fig. 7. *Talarocera nigripennis*, male and female antennæ, from the side, much enlarged.

Often the arista has short hairs fringing the upper and lower sides, in which cases it is called *pubescent* (fig. 5, 5); when the hairs are longer and more feather-like (fig. 5, 6), the arista is said to be *plumose;* or, if the hairs are fewer and stronger and confined to one side, *pectinated*. The pubescence or plumosity is almost always more marked on the upper side of the arista; the pectination is very rarely on the under side (*Ommatius*, Asilidæ).

THORAX.

The thorax is composed, as in other insects, of three parts, the *pro*-thorax, the *meso*-thorax and the *meta*-thorax, but the first and the last are so aborted as to present but few anatomical characters. The prothorax is perhaps most readily distinguishable in the nematocerous flies, forming a rounded *collar* back of the neck. The

metathorax is not seen at all from above; the *scutellum*, cut off by an impressed line, usually a semi-oval body, really belongs to the mesothorax, the dorsum of which is often called the *mesonotum*.

Transverse suture, an impressed line usually running straight across the mesonotum and terminating a little in front of the root of the wings. It is more or less incomplete in the middle.

Humerus or humeral callus, each of the anterior superior angles of the mesothorax, usually a more or less rounded callus.

Post-alar callus, a more or less distinct, rounded swelling, situated between the root of the wing and the scutellum.

Pre-alar callus, a similar, but usually less prominent, projection situated before the root of the wings on the sides of the mesonotum, just back of the outer ends of the transverse suture.

Scutellar bridge, a small ridge on either side of the scutellum, connecting it with the mesonotum.

Presutural depression, a depression, usually triangular in shape, at the outer ends of the transverse suture, near the dorsopleural suture.

Supra-alar groove, a groove on the mesothorax immediately above the root of the wings, along the inner margin of which there are, usually, characteristic bristles.

Fig. 8. Pleural divisions of *Syrphus*.

Pro, propleura.
Meso, mesopleura.
Sterno, sternopleura.
Ptero, pteropleura.
Hypo, hypopleura.
Meta, metapleura.

Notopleural or *dorsopleural suture*, the suture running from the humerus to the root of the wings, separating the mesonotum from the pleura.

Sternopleural suture, the suture below the dorsopleural suture, nearly parallel with it and separating the mesopleura from the sternopleura.

Mesopleural suture, the suture running from the root of the wings downward and separating the mesopleura from the pteropleura.

Mesopleura, the space situated in front of the root of the wings, between the dorsopleural and sternopleural sutures.

Pteropleura, situated below the root of the wings, back of the mesopleural suture.

Sternopleura, the lower part of the pleura, below the sternopleural suture and above the front coxa.

Hypopleura, the space over the middle and hind coxæ, below the metapleura.

Metapleura, the 'sides of the metanotum', a more or less swollen space at the outside of the metanotum and between it and the pteropleura and hypopleura.

Metanotum, the oval, arched portion below or behind the scutellum. It is frequently most easily observable in flies with a long, slender abdomen, as the Tipulidæ.

Halteres, balancers or poisers, rudimentary posterior wings, a slender organ with a dilated head, situated below each metapleura.

Squamæ, *Tegulæ* or *Calyptræ*, a pair of membranous scales situated above the halteres and back of the root of the wings, one above the other. The lower one or both may be rudimentary or absent; the upper one moves with the wings and is called the antitegula by Osten Sacken. Comstock, however, objects to this use of tegula, saying that the term was first used for the cup-like scale above the root of the wing in certain hymenoptera, and should

be reserved for that organ; he calls them *alulæ*, a term generally applied to the proximal posterior lobe of the wing.

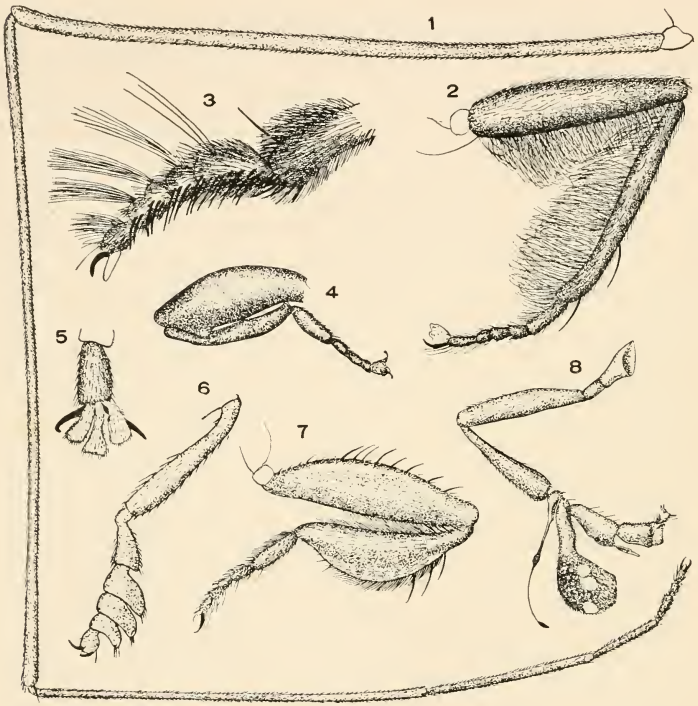


Fig. 9. Legs. 1, leg of Tipulid; 2, middle leg of *Peckia præceps*, male; 3, hind foot of *Mallophora scopipeda*, male; 4, hind leg of *Tropidia quadrata;* 5, last tarsal joint of *Dialysis;* 6, front leg of *Stegana horæ*, male; 7, hind leg *Rhopalomera ciliata;* 8, hind leg of *Calotarsa*, male.

LEGS.

The three pairs of legs are attached to the prothorax, mesothorax and metathorax, and are called, respectively the front, middle and hind pairs. When the front and middle pairs are spoken of together they should be call-

ed, for the sake of exactness, the anterior legs; when the middle and hind pairs are collectively meant, the posterior legs. The legs are composed of five parts:

Coxa, the part attaching the legs proper to the thorax.

Trochanter, the short, small, ring-like portion between the femur and coxa.

Femur, almost invariably the longest and stoutest portion of the legs, often provided with tubercles, spines or projections or sometimes greatly thickened; usually slender.

Tibia, the next part succeeding the femur, and like it often with various ornamentations or projections. When it terminates in one or more distinct, short, bristly spines, it is said to be *spurred*.

Tarsus, the distal division of the legs, composed (except in some abnormal forms) of five joints, of which the first, that next to the tibia, is called the *metatarsus*. On the terminal, or fifth joint, are the

Ungues or *claws*, usually two, curved, movable hooklets on the under side of the last tarsal joint, at the base of which below, are a pair of

Pulvilli (fig. 10), two pad-like, fleshy cushions attached to the last joint of the tarsus below the claw, usually present, but often absent among the Orthorrhapha and often much larger and better developed in the male than the female. They are sometimes elongate, but are more usually rounded, and provided with hairs. Between them is the

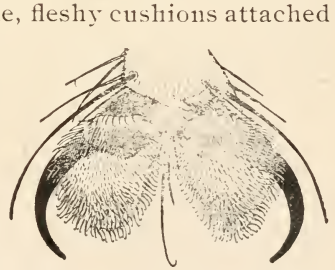


Fig. 10. Claws and pulvilli of domestic fly. After Kellogg.

Empodium, a median appendage on the under side of and between the claws, either in the form of a pad, like the pulvilli (fig. 9–5), when it is called pulvilliform, or like a bristle or spine (see Asilidæ, fig. 31), sometimes

it is alone present and the pulvilli are wanting (see Bibionidæ, fig. 7a).

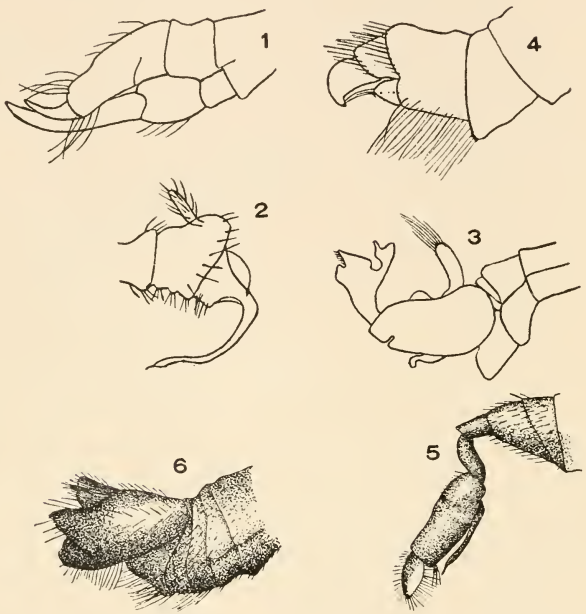


Fig. 11. Male genitalia. 1, Tipulidæ (*Diotrepha*); 2 Tipulidæ (*Atarba*); 3, Tipulidæ (indet.); 4, Culicidæ (*Aedes*); 5, Dolichopodidæ (*Dolichopus*); 6, Asilidæ (*Asilus*).

ABDOMEN.

The abdomen is composed of a variable number of segments, more or less closely fused together. The normal number for insects, nine, are rarely all visible (the Tipulidæ are examples). They are counted from the base on the upper side. In not a few cases the first two are so closely fused together, and the first one abbreviated, that the nomenclature leaves some doubt in the mind of the student. The upper part of the abdomen may be especially indicated by the word *dorsum*, but in general, the

venter or under part is alone thus contradistinguished, The male genitalia, which in many cases are of complicated structure, and of much value in classification, are known collectively as the *hypopygium*, and this term is usually restricted to the male genitalia, though sometimes used also for the female organs. The *ovipositor* of the female abdomen very frequently projects from the abdomen, and is sometimes extremely long; its structure may be characteristic of genera or families. The more detailed description of the parts of both these organs it is unnecessary to go into here; they may be studied in the different families, where they often find useful application in the separation of species, though rarely of genera.

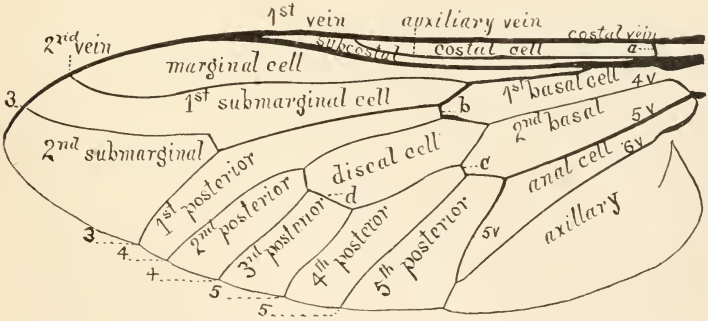


Fig. 12. Wing of *Tabanus*.

WINGS.

To understand the *venation* or *neuration* of the wings the student may select a common large horsefly (Tabanidæ). Observe near the middle of the wing directed transversely, a large, oblong, five or six sided cell, surrounded on all sides by other cells. This is the *discal* cell and is present in nearly all flies. Somewhere on the vein (fourth *longitudinal*), that bounds this cell in front, will be seen a short connecting vein, directed anteriorly,

the *anterior*, *small* or *middle cross-vein (b)*, which is very constant in flies, and affords in most cases, a key to the venation, no matter how intricate. It connects with the third longitudinal vein in front (in a few cases the second longitudinal vein); the cell behind it is the discal, in front, between the second and third longitudinal veins, the *first submarginal;* on the outer side the *first posterior;* on the inner side the *first basal.* Just back of the first basal cell and separated from it by the fourth longitudinal vein, is the *second basal cell;* back of the second basal and separated by the fifth longitudinal vein, is the third basal or *anal cell.* Back of the anal cell and including the free posterior proximal portion of the wing is the *axillary cell.* In the horsefly the anal cell is seen to run back obliquely to near the posterior margin of the wing, where it terminates acutely, that is, the anal cell is closed near the border of the wing; should the two veins that close it run separately into the margin of the wing, then the cell is said to be open. Counting from the third longitudinal vein (posterior branch) backward along the posterior border of the wing, to the vein that closes the anal cell outwardly, the student will count five different cells, the first of which, as already said, borders on the first basal cell, the second and third on the discal cell, the fourth on the discal and second basal cell, and the fifth on the second basal and anal cells; these cells are called the *posterior cells*, and are numbered from before back; the *first* is bounded by the third and fourth longitudinal and the anterior cross-vein; the *second posterior* by the anterior branch of the fourth vein in front, its posterior branch internally and behind, often superfluously called the anterior intercalary vein; the *third posterior* cell is bounded in front by the posterior branch of the fourth vein, internally by the *posterior cross vein* (*d*), posteriorly by the anterior branch of the fifth vein; the *fourth posterior*

cell is bounded in front and internally by the anterior branch of the fifth vein, bordering the discal and basal cells, posteriorly by the posterior branch of the fifth, often also superfluously called the posterior intercalary vein; this cell in other flies often borders on the discal cell alone internally; the *fifth posterior* cell is bounded in front by the posterior branch of the fifth vein, internally by the petiole of the fifth vein, posteriorly or internally by the *posterior basal cross-vein*. There is much doubt as to whether this latter is really a cross-vein in the more evident meaning of the word, or whether it really represents the primary branch of the fifth vein, since in many flies this is the only termination of the vein, the anterior branches being wholly wanting. The short vein which separates the discal cell from the second basal cell is often called the *anterior basal cross-vein;* sometimes the *discal cross-vein*, which would be the better term, were it not to be confused with the posterior cross-vein itself. Following the third longitudinal vein outwardly it will be found to give off an anterior branch, which runs forward to terminate in the anterior marginal vein of the wing, the costa; the cell included in this fork, between the branch and the vein itself is called the *second submarginal* cell, and this name should always be restricted to the cell so bounded, though usually the cell enclosed between the branches of the second longitudinal vein in the Culicidæ, Tipulidæ, etc., receives this name. The second longitudinal vein borders the first submarginal cell in front and terminates in the *costa*, as the encompassing vein of the wing is called; in a relatively few flies this vein also gives off a branch in front, dividing the *marginal* cell just as the submarginal cell is divided in *Tabanus*. Between the first longitudinal vein, which has a similar course to that of the second longitudinal, though shorter, and the vein in front of it, between it and the costal bor-

der, and called the *auxiliary* vein, is the subcostal cell; between the *auxiliary* vein and the costal border itself is the *costal* cell.

Finally, near the root of the wing, a short, but very constant cross-vein connecting the auxiliary vein with the costa is the *humeral cross-vein (a)*.

The above is the nomenclature of the wing now having almost universal vogue among descriptive entomologists, a system which, with minor modifications, has been used almost from the beginning of descriptive dipterology. It has no especial superiority over other systems to commend it, nor has it any striking disadvantages to con-

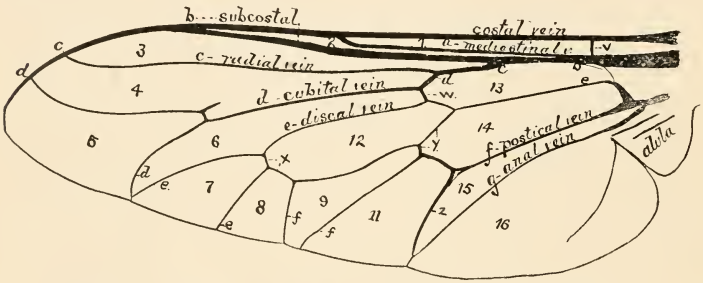


Fig. 13. Wing of *Pangonia*. Schiner's nomenclature.
1, costal cell; 2, mediastinal cell; 3, subcostal cell; 4, 5, cubital cells; 6, 7, 8, 9, 11, first–fifth posterior cells; 12, discoidal cell; 13, 14, 15, first–third basal cells; 16, axillary cell.

demn it; and long usage has apparently fixed it. Another system in vogue at the present time among a few dipterological authorities is that used by Schiner in his later writings, and, which, could it displace the older system, would have much to commend it. It will be readily understood by the comparison of the two figures given. The only confusion it makes with the older system is in the use of mediastinal cell for subcostal and subcostal for marginal, and this confusion is actually apparent in the writings of some authors, of whom Verrall is an example.

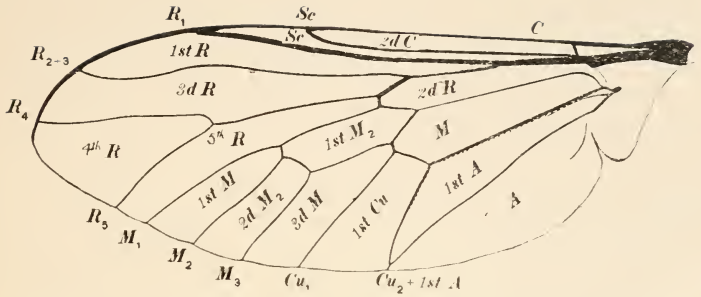


Fig. 14. Wing of *Silvius*. Comstock-Needham nomenclature.

A third system is that proposed by Comstock and Needham about ten years ago, but which has found practically no acceptance among dipterologists, with the exception of one or two American writers. There is much to be said in favor of a universal system of nomenclature among entomologists, a consummation devoutly to be wished. The present work, however, is no place for propagandism, and the common nomenclature has been everywhere employed in the following pages. The individual writer may do as he chooses in the use of either of the three systems, though he would do well to remember that ephemeral writings or briefer communications will suffer by the use of any except the standard; only thorough monographic studies with abundant illustrations will do much toward commanding the acceptance of either of the less used nomenclatures. I give below in tabular form the synonymy of the three systems for the *Tabanus* wing:

Auxiliary vein	II	Subcostal	Mediastinal
First longitudinal . . .	III1	Radial 1 . .	Subcostal
Second longitudinal . .	III3	Radial 3 . .	Radial
Third longitudinal . . .	III4,5	Radial 4, 5 .	Cubital
Fourth longitudinal . .	V1,2	Cubital 1, 2 .	Discoidal
Fifth longitudinal . . .	V3	Cubital 3 . .	Postical

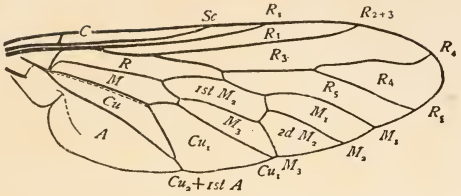


Fig. 15.

Rhyphus
(Rhyphidæ).

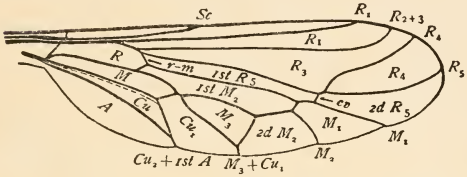


Fig. 16.

Enlonchus
(Cyrtidæ).

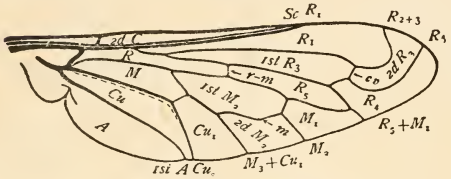


Fig. 17.

Pantarbes
(Bombyliidæ).

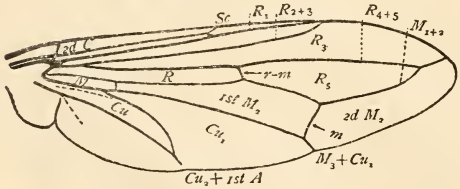


Fig. 18.

Conops
(Conopidæ).

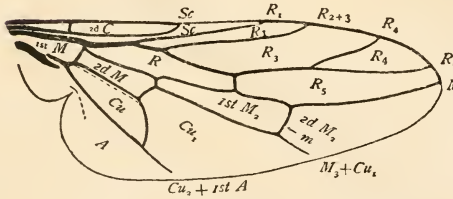


Fig. 19.

Scenopinus
(Scenopinidæ).

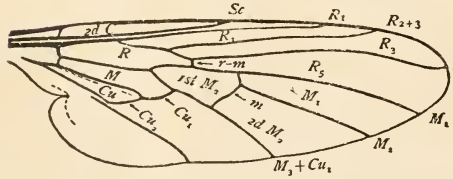


Fig. 20.

Rhamphomyia
(Empididæ.)

Venation, after Comstock and Needham.

Sixth longitudinal	IX	Anal	Anal
Humeral cross-vein			(*v*) Basal cross-vein
Anterior cross-vein			(*w*) Median cross-vein
Posterior cross-vein			(*x*) Posterior cross-vein
Anterior basal or discal cross-vein			(*y*) Discoidal cross-vein
Costal cell	2ndI		Costal
Subcostal cell	II		Mediastinal
Marginal cell	III		Subcostal
First submarginal cell	III_3		First cubital
Second submarginal cell	III_4		Second cubital
First basal cell	2ndIII		First basal
Second basal cell	V		Second basal
Anal cell	VIII		Third basal
Axillary cell	IX		Axillary
First posterior cell	III_5		First posterior
Second posterior cell	VI		Second posterior
Third posterior cell	$2ndV_2$		Third posterior
Fourth posterior cell	V_3		Fourth posterior
Fifth posterior cell	VIII		Fifth posterior
Discal cell	$1st V_2$		Discoidal

VESTITURE.

Flies differ much in the nature of their vestiture. Many are nearly or quite bare; others have a thick, woolly covering of closely set, fine hair; while others still are covered abundantly with a long, stout and heavy bristles or macrochætæ. Doubtless the vestiture has an intimate relation with the habits of the mature insect; just what the relations of the different kinds are, is not yet well understood. Osten Sacken has observed that the eremochætous kinds (that is those diptera in which there is a general absence of bristles, as, for example, the Stratiomyidæ, Leptidæ and Tabanidæ) are, for the most part, holoptic in the male sex, and at the same time are chiefly aerial in habit, flying swiftly and often hovering, using the legs only for alighting and resting. On the contrary, the chætophorous flies (as the Muscidæ in the wide sense, Phoridæ, Dolichopodidæ, Asilidæ, etc.)

are for the most part ambulatory insects, using their legs as much as, sometimes more than the wings in locomotion; or, if not, for grasping, seizing or holding their prey; they seldom have the eyes contiguous in the male sex. Probably the macrochætæ reach their highest development among the Tachinidæ, as for instance in

Fig. 21. *Paradejeania*, sp. (Brazil). Enlarged.

Dejeania, *Paradejeania*, etc., and the Dexiidæ (*Hystrichodexia*), where the abdomen may be almost covered with long, erect, very rigid spines.

As concerns other kinds of vestiture, the usage of writers is not very exact; the terms hair, pile, pubescence, tomentum, being used with a wide degree of latitude. In general, however, *pile* should be restricted to indicate closely and thickly set, erect, fine hair like the pile of velvet; while the term *hair* may be used to designate longer, less erect, and less abundant pelage. *Pu-*

bescence should be restricted to short, recumbent, fine hairs, while *tomentum* can only correctly be used as the designation for flattened, scale-like or stubble-like, more or less recumbent hairs, which gradually merge into *dust* or *pollen*, which is so generally present in diptera, and upon which the determination of many species must largely depend.

CHÆTOTAXY.

Many years ago Rondani proposed the term *macrochætæ* for the large, differentiated bristles of flies, and suggested their use in classification, though he made but little use of them himself. Loew also failed to appreciate their full significance in the classification of diptera, although he made considerable use of them, examples of which may be found in his diagnostic characterization of the Helomyzidæ and Ortalidæ. It was Osten Sacken who proposed the term *chætotaxy* to designate the science of their arrangement, and who published an epoch-making paper on the subject in 1881. Girschner, later, extended the system more widely for the calyptrate diptera. At the present time a thorough knowledge of chætotaxy is indispensable for all who would deal with those families, especially of the Cyclorrhapha, in which they are, for the most part, so conspicuous, and upon which the generic and specific distributions so much depend. Osten Sacken, indeed, makes the arrangement of the bristles almost fundamental as indices of relationships, and exaggerates their importance in some instances, especially so when he would locate the Apioceridæ with the Asilidæ, almost solely on their chætophorous character. *Hilarimorpha* he refuses admission to the Empididæ chiefly because of the absence of bristles, forgetting that some true Empididæ also absolutely lack bristles. However it may be in particular instances, there can be no question

but that the number and arrangement of bristles in most cases offer important, in some cases perhaps the only, available criteria in generic classification. For that reason it behooves the student to become familiar with the subject, and to pay especial attention to their use in many, if not most of the groups.

CEPHALIC BRISTLES.

Vertical, two pairs, inner and outer, inserted more or less behind the upper and inner corner of the eye, erect or the inner pair convergent, the outer divergent; the outer pair is usually the smaller and more frequently absent.

Postvertical, in the middle, near or back of the vertex, convergent, erect or divergent; usually small, and often absent.

Ocellar, situated close to the ocelli, usually the foremost ocellus; usually directed forward; often minute or absent.

Frontal, a row of bristles on either side of the median vitta descending often to or below the root of the antennæ on the side of the face anteriorly; of much use in the classification of the Calypteræ.

Fronto-orbital, a bristle or bristles on each side of the front near the orbit, immediately below the vertical bristles; there may be one, two, or none on each side.

Lower fronto-orbital, situated on the lower part of the front near the eyes, and not quite in line with the fronto-orbitals. They are not of frequent occurrence.

Cruciate, a pair of bristles in the middle of the lower part of the front, directed inwardly and forwardly; observed in some Calypteræ and Acalypteræ.

Vibrissa, a stout bristle situated near or a little above the oral margin, near the front edge of the mouth opening; of important use in the classification of the Acalypteræ.

Facial, a series of bristles on either side of the middle

of the face, above the vibrissa, especially conspicuous among many genera of the Tachinidæ, but usually absent in the Acalypteræ.

Lateral facial, one or two bristles sometimes present on the sides of the face below, toward the eye.

Postorbital, a line of small bristles nearly parallel with the posterior margin of the eye, on the edge of the occiput.

MESONOTAL BRISTLES.

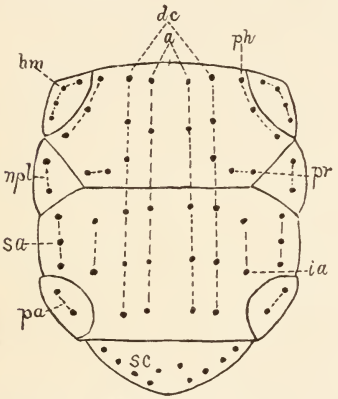


Fig. 22. Mesonotal bristles.

Humeral (hm), one or more bristles inserted on the humeral callus.

Posthumeral (ph), one or more bristles situated on the inner margin of the humeral callosity.

Notopleural (npl), usually two, inserted immediately above the dorsopleural suture, between the humeral callus and the root of the wing, on the bottom of the presutural depression.

Presutural (pr), one or more bristles situated immediately in front of the transverse suture, above the presutural depression.

Supraalar (sa), usually one to three bristles above the root of the wings, between the notopleural and postalar bristles.

Intraalar (ia), a row or two or three bristles between the supraalar group and the dorsocentral bristles.

Postalar (pa), bristles on the postalar callus, back of the supraalar.

Dorsocentral (dc), a row on the inner part of the dorsum, at the outer side of the acrostichal.

Acrostichal (a), a row next to the median line, on the inner side of the dorsocentral; sometimes both the dorso-

central and acrostichal are represented by the hindmost bristles forming a *prescutellar* row in front of the scutellum.

Scutellar, bristles along the margin of the scutellum, which may be distinguished from the *Dorsoscutellar*.

Pleural bristles.

Propleural, a bristle or bristles inserted on the lower part of the propleura, immediately above the front coxa.

Mesopleural, bristles inserted on the mesopleura, near the angle formed by the dorsopleural and mesopleural sutures.

Sternopleural, one or several bristles below the sternopleural suture; mesothoracic of Loew.

Pteropleural, bristles inserted on the pteropleura, rarely present and difficult to distinguish.

Metapleural, bristles inserted on the metapleura, especially conspicuous in the Asilidæ, and named by Lynch the

Trichostical bristles, a fan-like row on the metapleura, conspicuous in some families.

Hypopleural bristles, a row or tuft of usually small bristles on the hypopleura, occurring in the Tachinidæ, Dexiidæ, Sarcophagidæ, and a part of the Muscidæ, first recognized by Osten Sacken.

Abdominal bristles.

Marginal bristles, bristles inserted on the posterior margins of the segments above, especially conspicuous in many Tachinidæ.

Discal bristles, usually one or more pairs inserted near the middle of the segments before the hind margins.

Lateral bristles, one or more bristles situated on or near the lateral margins of the segments.

In addition, a number of terms are used to designate the inclination of the bristles, often important in describing the cephalic bristles. The more important of these

are: *erect*, when standing perpendicularly or nearly so; *proclinate*, when directed forward; *reclinate* when directed backward; *divaricate* or *divergent* when directed outward from the middle line; *convergent* when directed inwardly; *decussate* or *cruciate* when crossing each other.

INTERNAL ANATOMY.

For the following brief account of the internal anatomy of Diptera I am indebted to Prof. V. L. Kellogg.

The special features of the internal structure of the Diptera are the high degree of concentration of the nervous system attained in some of the members of the order, the expansion of the two main tracheal trunks in the base of the abdomen to form air sacs, the presence of a sucking stomach as in the Lepidoptera, the constant number (four, rarely five) of the Malphigian tubes, and the absence of a bursa copulatrix in the females.

The alimentary canal presents behind the œsophagus an expansion which is a crop or sucking stomach. The ventriculus, or true stomach, lying behind it, has usually two cæca; and the long, slender, Malphigian vessels are, in almost all species, four in number, a surprising constancy compared with the condition in other groups of specialized insects. The vessels open singly into the alimentary canal in some flies and in others they unite in pairs before reaching the canal and open into it by two ducts.

The heart is of the usual type, but with only two chambers in the more specialized families, owing to the concentration of the body. In the larva of *Corethra* the heart is a simple, elongate tube without chambers.

The two main tracheal trunks expand at the base of the abdomen into conspicuous air sacs similar to those found among Hymenoptera, Lepidoptera, the lamellicorn beetles and some other insects. The two pairs of spira-

cles of the thorax are provided with 'vocal cords', and a considerable part of the humming sound is produced by those structures. The abdominal spiracles of some flies are as primitive as are to be found among insects, being simply unlipped openings.

The condition of the nervous system varies greatly within the order. In the elongate, more generalized nematocerous forms there are five or six abdominal ganglia, and three distinct thoracic ganglia. From this condition to that shown by the Muscidæ, where all the thoracic and abdominal ganglia are united into one large ganglion in the thorax, a most instructive series of gradatory forms is presented. In the Empididæ, which stand intermediately as regards the concentration of the ventral cord, the two anterior thoracic ganglia are fused into one; this condition is radically different from that shown by insects of other orders, as the Coleoptera, Lepidoptera and Hymenoptera, which have but two thoracic ganglia. In these insects, however, it is the two posterior ganglia (meso- and metathoracic) which are fused into one.

The studies of Child on the so-called Johnston's organ (located in the second antennal joint), an elaborate structure of fine chitin rods connected with special nerve cells and these connected by fine nerves with the main antennal nerve, seem to ascribe definitely an auditory function to the antennæ. Kellogg has shown that the divided eyes of such flies as the Blepharoceridæ and others (indicated externally by the division of the corneal facets into two regions in which the facets are of different size) are in reality made up two types of ommatidia, one type being much larger and much less strongly supplied with retinal pigment than the other type. This condition produces a certain sort of differentiation of the visual function, one part of the eye being better adapted for seeing

swiftly moving objects, or in twilight than the other, but the other part better adapted for the formation of a precise image.

Special nerve structures are present at the base of the halteres, and orienting, auditory and other sense functions have been ascribed to these organs by various morphologists. Flies from which these organs have been removed are utterly unable properly to direct their flight.

The internal organs of the reproductive system present some interesting peculiarities. The ovaries of the female consist of an exceptionally large number of egg-tubes. There are three spermathecæ, paired accessory organs, and no true bursa copulatrix. The males have two oval testes with short vasa defferentia. The testes are not infrequently colored, possessing a pigment layer. There is a well developed penis with accessory copulatory organs. Snodgrass' interesting studies on the comparative anatomy of the external genital organs show that while there may be great variety in these structures among the males of any one family, the females, curiously enough, show a remarkable uniformity of the hypopygial organs.

CLASSIFICATION OF DIPTERA.

The first real attempt at the subdivision of the order of Diptera was made by Latreille in 1805, when he distinguished between the nematocerous and brachycerous forms. The term Nemocera was introduced by him in 1817, and the characters upon which he based the group are yet employed. The name Brachocera was applied to the remaining Diptera by Macquart in 1834. The characters he used, following Latreille, were:

Antennæ at least six-jointed; palpi four or five-jointed. **Nemocera.**
Antennæ three-jointed; palpi one or two-jointed. **Brachycera.**

This attempt at subdivision, based upon the antennæ and palpi, was all that had been made until a compara-

tively recent date. It is the classification followed by Loew in the first volume of the Monographs published as late as 1862. In 1863 Brauer proposed a more rational division of the Diptera into the two suborders, Orthorrhapha and Cyclorrhapha, based chiefly upon larval and pupal characters. Their characters in a later publication he gives as follows:

Larvæ with a 'jaw-capsule' (Kieferkapsel) or a differentiated head. Pupæ free or enclosed in the larval skin; in either case the larval skin bursts for the extrication of the pupa or imago in a T-shaped opening on the back of the anterior end, or rarely in a transverse rent between the eighth and ninth abdominal rings. The imago lacks the frontal lunule and ptilinum. . . . . **Orthorrhapha.**

Larvæ without differentiated head. Pupæ always enclosed in the hardened larval skin (forming the so-called puparium); the imago always escaping from the anterior end through a circular orifice. Frontal lunule present; ptilinum usually present. . . **Cyclorrhapha.**

More recently Brauer proposed a further subdivision of the suborders into tribes and groups as follows:

BRAUER'S CLASSIFICATION.

Suborder Orthorrhapha.

Section I. Nematocera.

Tribe 1. Eucephala. Families Mycetophilidæ, Bibionidæ, Chironomidæ, Culicidæ, Blepharoceridæ, Simuliidæ, Psychodidæ, Ptychopteridæ, Rhyphidæ.

Tribe 2. Oligoneura. Family Cecidomyidæ.

Tribe 3. Polyneura. Tipulidæ, Limnobiidæ.

Section II. Brachycera.

Tribe 4. Acroptera. Family Lonchopteridæ.

Tribe 5. Platygenya.

Group 1. Homöodactyla.

Superfamily 1. Notacantha. Families Stratiomyidæ, Xylophagidæ.

Superfamily 2. Tanystoma. Families Tabanidæ, Acanthomeridæ, Leptidæ.

Superfamily 3. Bombylimorpha. Families Nemistrinidæ, Acroceridæ.

Group 2. Heterodactyla.

Superfamily 1. Procephala. Families Mydaidæ, Asilidæ, Bombyliidæ.

Tribe 6. Orthogenya. Families Empidæ, Dolichopodidæ.

Suborder Cylorrhapha.
Section I. Aschiza.
Tribe 1. Syrphidæ. Families Syrphidæ, Pipunculidæ.
Tribe 2. Hypocera. Families Phoridæ, Platypezidæ.
Section II. Schizophora.
Tribe 3. Eumyidæ.
Superfamily Schizometopa. Calypteræ of the present work.
Superfamily Holometopa. Acalypteræ of the present work.
Tribe 4. Pupipara. Pupipara of authors, Eproboscidea.

SCHINER'S CLASSIFICATION.

Orthorhapha.
Nematocera.
Oligoneura—Cecidomyidæ, Mycetophilidæ, Simulidæ, Bibionidæ.
Polyneura—Chironomidæ, Blepharoceridæ, Psychodidæ, Culicidæ, Tipulidæ, Dexidæ, Rhyphidæ.
Brachocera.
Cyclocera—Stratiomyidæ, Xylophagidæ, Coenomyidæ, Acanthomeridæ, Tabanidæ.
Orthocera—Nemistrinidæ, Bombylidæ, Acroceridæ, Therevidæ, Midasidæ, Asilidæ, Leptidæ, Empidæ, Dolichopidæ.
Cyclorhapha.
Proboscidea.
Hypocera—Phoridæ.
Orthocera.
Oligoneura.
Muscidæ acalypteræ—Borborinæ, Phycodrominæ, Scatophaginæ, Thyreophinæ, Rhopalomerinæ, Helomyzinæ, Dryomyzinæ, Sciomyzinæ, Tetanocerinæ, Geomyzinæ, Drosophilinæ, Ephydrinæ, Chloropinæ, Psilinæ, Sepsinæ, Calobatinæ, Michogastrinæ, Achinæ, Diopsidinæ, Dacinæ, Trypetinæ, Sapromyzinæ, Ulidinæ, Platystominæ, Dorycerinæ, Pyrgotinæ, Ortalinæ, Agromyzinæ, Milichinæ, Ochthiphilinæ, Heteroneurinæ, Cordylurinæ.
Muscidæ calypteræ—Tachininæ, Muscinæ, Dexinæ, Sarcophaginæ, Anthomyinæ.
Oestridæ.
Polyneura—Platypezidæ, Pipunculidæ, Syrphidæ, Conopidæ.
Eproboscidea—Hippoboscidæ, Nycteribidæ.

OSTEN SACKEN'S CLASSIFICATION.

Osten Sacken has offered many pertinent criticisms of Brauer's classification, insisting that the Nemocera and Brachycera are divisions of more fundamental importance than was assigned to them by Brauer. His classification, so far as it was developed by him, is as follows:

Suborder Orthorrhapha Nematocera. Palpi usually four or five-jointed, pendulous and more or less filiform. Antennæ many jointed (more than six-jointed), usually filiform (seldom pectinate), with the majority of the joints of the flagellum homologous (homomorphous).

Superfamily Nemocera Vera. Males dichoptic;* no bisection or bicoloration of the eyes. Antennæ provided with sensitive hairs arranged symmetrically on the flagellum in verticils or pencils (except Mycetophilidæ). No pulvilli;† empodia often, but not always present.

A. Larvæ peripneustic,‡ always terrestrial. Cecidomyidæ, Mycetophilidæ.

B. Larvæ peripneustic or amphipneustic, aquatic, subaquatic, sometimes terrestrial. Culicidæ, Chironomidæ, Psychodidæ, Dixidæ, Tipulidæ.

Superfamily Nemocera Anomala. Diptera with homologous (homomorphous) joints to the flagellum; usually four-jointed palpi. Males frequently holoptic, sometimes the females also. Pulvilli usually present. Antennæ without sensitive hairs. Ocelli usually present. Bibionidæ, Simulidæ, Blepharoceridæ, Rhyphidæ, Orphnephilidæ.

Suborder Orthorrhapha Brachycera. Palpi not more than two-jointed, not pendulous, the end joint more or less clavate, and larger than the basal one; joints of the antennal flagellum, with rare exceptions, not homologous.

Superfamily Eremochæta. No macrochætæ. Three well developed pulvilli. Males predominately holoptic, the eyes often bisected. Antennal flagellum polymorphous. Axillary incision, alula and antitegula in most cases distinctly developed. Discal cell usual-

*They are sometimes truly holoptic.

†Recent investigations show that true pulvilli are sometimes present.

‡ *Amphipneustic* larvæ are those in which the spiracles are confined to the first and last segments: *metapneustic* those in which they are confined to the posterior segments; *peripneustic* those in which they are present on the median rings.

ly developed; usually five posterior cells. Legs rather smooth. Stratiomyidæ, Tabanidæ, Acanthomeridæ, Leptidæ.

Superfamily Tromoptera. Chiefly hovering flies. Nemistrinidæ, Bombyliidæ, Cyrtidæ, Therevidæ, Scenopinidæ.

Superfamily Energopoda. Pedestrian flies. Asilidæ, Dolichopodidæ, Lonchopteridæ, probably Phoridæ.

Superfamily Mydaidæ. Mydaidæ.

Suborder Cyclorrhapha Athericera. All other flies.

COQUILLETT'S CLASSIFICATION—1901.

Recently Mr. D. W. Coquillett has proposed another system, differing from any preceding one, and for the most part with new names, as follows:

Suborder Eproboscidea Latreille.
Families Hippoboscidæ, Nycteribidæ.
Suborder Proboscidea Latreille.
Section Orthorrhapha Brauer.
Subsection Nemocera Latreille.
Superfamily Tipuloidea Coquillett.
Families Tipulidæ, Dixidæ, Culicidæ, Psychodidæ, Stenoxenidæ, Chironomidæ, Cecidomyidæ, Mycetophilidæ.
Superfamily Bibionoidea Coquillett.
Families Bibionidæ, Simulidæ, Orphnephilidæ, Belpharoceridæ, Rhyphidæ.
Subsection Brachycera Macquart.
Superfamily Tabanoidea Coquillett.
Families Leptidæ, Stratiomyidæ, Acanthomeridæ Tabanidæ, Acroceridæ, Nemistrinidæ.
Superfamily Bombyloidea Coquillett.
Families Apioceridæ, Mydaidæ, Bombylidæ.
Superfamily Asiloidea Coquillett.
Families Scenopinidæ, Therevidæ, Asilidæ, Empidæ Dolichopodidæ.
Superfamily Phoroidea Coquillett.
Families Lonchopteridæ, Phoridæ.
Section Cyclorrhapha Brauer.
Superfamily Syrphoidea Coquillett,
Families Platypezidæ, Pipunculidæ, Syrphidæ, Conopidæ.

Superfamily Muscoidea Coquillett.
Group Calypteratæ Desvoidy.
Families Oestridæ, Tachinidæ, Dexidæ, Sarcophagidæ, Muscidæ, Anthomyidæ.
Group Acalypteræ Macquart.
Families Scatophagidæ, Heteroneuridæ, Helomyzidæ, Phycodromidæ, Sciomyzidæ, Sapromyzidæ, Lonchæidæ, Ortalidæ, Trypetidæ, Micropezidæ, Sepsidæ, Psilidæ, Diopsidæ, Oscinidæ, Drosophilidæ, Geomyzidæ, Agromyzidæ, Borboridæ.

LAMEERE'S CLASSIFICATION.

Yet another pretentious scheme of the classification of Diptera is that of Prof. Aug. Lameere of the University of Brussels, which has very recently appeared.* The meritorious part of this ambitious attempt is the endeavor to apply the only real criteria in a true classification of insects, phylogeny. The author, however, is in deeper water than he suspected; but the scheme is worthy of reproduction because of several suggestions, though its inconsistencies clearly show that the author has not a wide acquaintance with the order.

NEMOCERA.
Polyneura.
Culicidæ.
Ptychopterinæ.
Ptychopterini.
Psychodini.
Culicinæ.
Dixini.
Culicini.
Chironomini.
Tipulidæ.
Limobiinæ.
Tipulinæ.

Oligoneura.
Mycetophilidæ.
Mycetophilinæ.
Mycetobiinæ.
Cecidomyidæ.
Sciarinæ.
Cecidomyinæ.
Lestremini.
Cecidomyini.
Heteropezini.

* Mem. Soc. Ent. de Belg. xii, 1906. 105.

BRACHYCERA.
- Metagnatha.
  - Rhyphidæ.
  - Bibionidæ.
    - Bibioninæ.
      - Bibionini.
      - Simuliini.
    - Orphephilinæ.
    - Blepharocerinæ.
- Metarhyncha.
  - Homœodactyla.
    - Stratiomyidæ.
      - Xylophaginæ.
      - Stratiomyinæ.
    - Leptidæ.
      - Leptinæ.
      - Nemistrinæ.
    - Tabanidæ.
      - Tabaninæ.
      - Acrocerinæ.
  - Heterodactyla.
    - Pleroneura.
      - Therevidæ.
        - Therevinæ.
          - Therevini.
          - Scenopinini.
        - Apiocerinæ.
      - Bombylidæ.
        - Anthracinæ.
        - Bombylinæ.
      - Asilidæ.
        - Asilinæ.
        - Midinæ (sic).
    - Eremoneura.
      - Orthorrhapha.
        - Empididæ.
          - Empidinæ.
          - Hybotinæ.
        - Dolichopodidæ.
          - Diaphorinæ.
          - Dolichopodinæ.
      - Cyclorrhapha.
        - Syrpharia.
          - Platypezidæ.
          - Lonchopteridæ.
          - Phoridæ.
          - Pipunculidæ.
          - Syrphidæ.
        - Myodaria.
          - Conopidæ.
          - Muscidæ.

I have given these more pretentious systems of classification of the diptera in order that the tyro in their study may not reach the erroneous conclusion that any system is authoritative. Frankly, I do not have a great deal of faith in any of them. They are, in part at least, the biased personal opinions of their authors, their individual views as to the importance of the different characters, opinions which can only reach an approximate equilibrium after we have a much greater knowledge of ancient types, and perhaps of the embryology of modern forms. Upon the whole, Osten Sacken has brought a wealth of

information to bear upon his views, though he by no means claimed finality for them. His exceptions, however, are so many and oftentimes so pertinent that I am by no means convinced about many things. Wherein all writers concur may safely be accepted by the student *ex authoritate*, but I would advise the inexpert student to make no use of most of the terms that have been proposed; nor fret himself about the value of any of them. The divisions Orthorrhapha and Cyclorrhapha may perhaps safely be accepted, since all, or nearly all, are agreed thereon, though by no means agreed as to their rank and limits. At one time, indeed, they were almost universally accepted as the two chief suborders, but within recent years there has been a tendency to subordinate them to the older groupings of Latreille and Macquart, perhaps in part due to the influence of Osten Sacken's authority. Osten Sacken endeavored to show that the characters recognized as distinctive of the Nemocera and Brachycera are of more fundamental importance than those distinguishing the Orthorrhapha and Cyclorrhapha. With this view I do not agree. I must still accept Brauer's chief divisions, as, upon the whole, the most natural grouping of the order.

Speiser believes that the Pupipara are only highly specialized muscids, and it is even doubtful yet whether some of them may not be oviparous in habit; we know of one species, at least, wingless and parasitic upon birds which stands on the border line. Wesche has recently asserted that the mouth-parts of the Pupipara are thoroughly muscid in structure. The vestigial eyes, small and partly aborted antennæ, bristly head, leathery abdomen and short stout legs are also characteristic of certain wingless, parasitic Phoridæ, and certainly no one will attempt to trace any immediate relationship with these flies. I believe there is a much closer relationship be-

tween the Streblidæ and Borboridæ, than between the Borboridæ and Empididæ, for instance.

I must insist, notwithstanding Osten Sacken's rather strongly asserted views to the contrary, that there is no distinct limitation between the Nemocera and Brachycera. If the reader will turn to the characters given in the family table further on, he will, I believe, appreciate the force of my statement. The antennæ of *Rhachicerus*, a 'brachycerous' fly, are in some respects among the most primitive or generalized of all diptera: we know of no living genus, unless it be *Cerozodia*, from which it could have been derived; doubtless some ancient tipulid may have been the forbear of the genus. Of course we can not positively say that these insects may not have reverted in the structure of the antennæ from a specialized to a generalized condition, but that is very improbable indeed—evolution is irreversible. It would seem, however, that all the Brachycera, save possibly *Rhachicerus*, have been evolved from a common ancestor, otherwise we are at a loss to explain the seemingly strange fact that the number eight is so common for the segments of the flagellum, and is never exceeded, with the above exception. If the 'posterior cross-vein' of the Brachycera is identical with the vein at the outer end of the discal cell in the Tipulidæ and Rhyphidæ, then it is apparent that all families, save these, of the Nemocera, are excluded from the ancestral line of the Brachycera.

Lameere, indeed, would divide the Nemocera and Brachycera between the Mycetophilildæ and Bibionidæ. But that is only begging the question, the two families are absolutely coalescent. The fact is that the structure of the head, antennæ, and palpi changes so gradually from the more generalized to the more specialized forms that nowhere can we draw an impassable line between the groups.

On the other hand the structure of the adult insects changes so much somewhere in the vicinity of the Syrphidæ, to say nothing of larval structure and habits, that I believe, if we must have suborders (which to me does not seem imperatively necessary) the place to make the division is somewhere between the Syrphidæ and Dolichopodidæ. There are groups here which are osculant no doubt—a lot of ink has been wasted in their discussion,—but so there are in all classifications. The sooner we learn, as learn we must, that dividing lines do not occur in nature except as accidents, that evolution never classified anything and never will, the sooner we shall get over some of the bugbears of taxonomy. The best we can do is to make such groupings as will express most clearly and most conveniently relationships, and especially the phylogeny of organisms.

As I have already said, a true classification of the diptera, as of all other organisms, is desirable, but not possible, for that would mean the absolute perfection of dipterological science. An approximation to that finished perfection is of course attainable, but that approximation must depend upon many factors which have as yet scarcely engaged the attention of students of diptera. Their embryology, geological history, geographic distribution, ethology and comparative anatomy, are among these factors. No dipterologist has ever given serious attention to the study of extinct forms, and no classification of any group of organisms has ever been satisfactory until such forms have been considered and seriously considered,—paleontology and embryology especially, are the sine qua non of any entomological classification, and, considering the relatively slight advances which have been made in the taxonomy of the diptera during the past half century, now seems the opportune time for such studies. What dipterologist will undertake them?

Without extending these remarks to an undue length it may be well to set down here the chief lines of evolution in diptera. As they seem to me they are as follows:

1. Reduction in the number of longitudinal veins from the primitive eight or nine; and of their branches.
2. Shortening of the most anterior and posterior of these, and the reduction of the basal cells.
3. Weakening of the posterior veins; loss of the marginal vein behind; loss of the primitive cross-veins. Powerful flyers with strong orienting powers have a supporting venation before the hind margin, produced either by adventitious cross-veins or the closure of cells.
4. Loss of antennal joints from thirty or more to three or two, by reduction in number of homologous joints; by the progressive fusion of the distal joints into the so-called 'complex'; or into the style or arista; or by the atrophy of the basal joint. The development in size of the simplified antenna; or the production of structural peculiarities.
5. Loss of palpal joints, and, as in the antennæ, the development of the simplified palpus.
6. The development of holopticism from a primitive dichopticism. I do not believe that the reverse is probable—the Acalypteræ have *not* descended from the Calypteræ, for instance, and these latter are, in this respect at least, as in others, the more highly specialized insects, just as *Bibio* is more highly specialized than *Mycetophila*.
7. Loss of ocelli; diminution and loss of the compound eyes, especially characteristic of ectoparasites.
8. Diminution in number of abdominal segments; the closer fusion of the thoracic segments.
9. Loss of tarsal joints; loss of empodium.

These of course are not all the lines of evolution in diptera, but I believe that they are all irreversible, that evolution has never recovered anything once functionally lost. Moreover all, or nearly all these lines of evolution are polyphyletic, resulting in numerous cases of parallel resemblances which must be taken into account in any attempt at *true* classification. *Heteropeza* among

the Cecidomyidæ is an excellent example of extraordinary reduction of wing veins, palpal joints and tarsal joints, though it still retains the primitive antennæ and other primitive characters which ally it with the more generalized forms of diptera. In other words, the evolution of characters in the different lines of descent does not proceed pari passu, and opinions will always differ as to the different values to be assigned to the specialized characters. *Nycteribia* and *Melophagus* are perhaps the most highly specialized of all insects, that is they have traveled further from the starting point. We do not for that reason deem them the most typical of insects, the most highly developed—far from it.

COLLECTION AND PRESERVATION OF DIPTERA.

Flies must be collected with much more care than can be safely used with such insects as coleoptera. Moisture of all kinds injures or ruins them, and specimens collected in alcohol are worthless. For this reason the collecting bottle should be lined throughout with blotting paper, and the cyanide placed in the cork; a very little poison suffices to kill them. Nor should they be allowed to become too dry before pinning. The pin should be thrust through the middle of the thorax, and the specimen placed just so as to enable the head of the pin to be grasped by the thumb and finger safely. Very small specimens should never be glued to card points, as is commonly done with coleoptera; they should always be pinned. Sometimes specimens may be collected and packed in some very fine, light sawdust impregnated with carbolic acid, where it is inconvenient or impossible to pin them. Such specimens being gently separated from the sawdust are allowed to remain for some hours, over, but not touching, damp sand before pinning. To pin the small

specimens, use narrow strips of good card-board or blotting paper, thrusting a slender pin through one end and allowing it to protrude just a little above the edge and clipping off the longer end with a pair of pliers. Thrust the point of the pin as held in the card-board, into the under-side of the insect, but not entirely through it, and a stronger pin in the reverse direction through the other end of the small strip. The pins are to be thrust through the card-board from edge to edge, and in consequence a good quality is to be selected that will not split too readily. The wings should never be spread, but should be turned aside so as not to conceal the abdomen. In the early part of the season many interesting species will be caught with the beating-net. The pointed end of the beating-net may be thrust, with its contents, into a bottle containing a little chloroform, or into a cyanide bottle, for a short time, when the specimens may be leisurely removed. Later in the season, flower-flies will be collected from a great variety of melliferous blossoms, and it is better to wait for the specimens to come to such blossoms than to go hastily about looking for them. I have collected from a single patch of elderberry blossoms, not a rod in diameter, more than forty species ot Syrphidæ within ten days. Not many species are to be found in shady woods, but those species must be sought for there. To preserve flies in the cabinet from their insect enemies, I use naphthaline. The head of ordinary pins, when heated red-hot, may be thrust into the common moth-balls sold by the druggists, which when thus mounted serve all purposes.

TABLE OF FAMILIES.

1. Flies of a leathery or horny structure, living parasitically upon warm-blooded vertebrates in the adult condition, the larvæ born when nearly ready to pupate; often wingless or with vestigial wings. 65

   Flies of a softer structure, not ectoparasites upon warm-blooded vertebrates, rarely viviparous. 2

2. Anal cell rarely narrowed in the border of the wing; antennæ usually composed of from eight to sixteen joints and more or less freely articulated with each other, usually longer than the thorax; not with a differentiated style or bristle;* palpi as a rule with four or five joints; discal cell usually absent. . 3

   Anal cell, if present, closed, or much narrowed in the border of the wing; discal cell almost always present; palpi never with more than two joints; antennæ usually composed of three joints with a differentiated style or bristle. 14

ORTHORRHAPHA.

A. NEMOCERA.

Anal cell rarely (some Bibionidæ, etc.) narrowed in the margin, if present; discal cell present only in many Tipulidæ and the Rhyphidæ; second longitudinal vein often furcate, the third very rarely if ever; palpi usually more or less elongate, composed of from one to five, usually four joints, rarely absent; antennæ usually elongate and verticillate, generally filiform, rarely pectinate, composed of from six to thirty-nine joints, usually from eight to sixteen, the joints of the flagellum homomorphic and usually freely articulated with each other, a style or arista very rarely differentiated. For the most part slender, delicate flies.*

3. Mesonotum with a complete, V-shaped suture (incompletely V-shaped and sinuous in the Ptychopterinæ). Wings many-veined, often with a complete discal cell; ocelli very rarely present; both sexes dichoptic. For the most part large, always slender, flies with long legs; never very small. Daddy-longlegs, craneflies.

   Tipulidæ, 81.

* *Chionea*, a wingless tipulid, has the third antennal joint ending in a slender, three-jointed style; the flagellum of the Orphnephilidæ is aristiform.

Mesonotum never with a complete V-shaped suture, rarely with any distinct suture. For the most part small or very small flies. 4

4. A complete discal cell present; antennæ twelve-sixteen jointed; empodia developed pulvilliform, the pulvilli absent. **Rhyphidæ**, 157.

No discal cell. 5

5. Antennæ composed apparently of two joints and a terminal arista, formed by nine or ten closely united segments; second basal cell present and small. Rare, small flies. **Orphnephilidæ**, 153.

Not such flies. 6

6. Wings with only a few longitudinal veins and no apparent cross-veins, almost always hairy; antennæ slender, usually twelve to sixteen-jointed; coxæ not elongate; tibiæ without terminal spurs; legs not thickened; ocelli present or absent. Small or minute, delicate, mostly gall producing flies. **Cecidomyidæ**, 117

Not such flies. 7

7. Ocelli present.* 12

No ocelli. 8

8. The marginal vein is not continuous beyond the tip of the wing. 9

The marginal vein encompasses the wing; second and fourth longitudinal veins furcate; many veined. 10

9. Antennæ slender; the joints more or less constricted, and often bushy plumose in the male; legs slender, the femora sometimes thickened; abdomen slender, wings usually narrow; no sexual holopticism. For the most part slender, delicate gnats; some small forms blood-sucking ('punkies'.) **Chironomidæ**, 110

Antennæ always shorter than the thorax, composed of ten or eleven closely united segments, and never plumose; legs strong, the hind pair more or less dilated; body thick-set, the abdomen ovate; anterior veins of wings stout, the posterior ones weak (compare certain Bibionidæ when in doubt as to the ocelli); males holoptic. Small or minute, blood-sucking flies; black flies, buffalo gnats, turkey gnats. . . **Simuliidæ**, 144

10. Wings ovate or pointed, with numerous longitudinal veins, and without apparent cross-veins; veins very hairy; tibiæ without

* The presence or absence of ocelli is not a family character; a few forms among both the Mycetophilidæ and Bibionidæ appear to lack them.

terminal spurs. Small or minute, moth-like flies, the wings when at rest folded roof-shaped; rarely (*Phlebotomus*) blood-sucking. . . . . **Psychodidæ**, 92.

Anterior cross-vein near middle of wing, distinct; second basal cell large and distinct; wings not folded roof-like when at rest. 11

11. Wings tomentose; fringed on the hind margin; antennæ of male usually bushy plumose; the second and third veins separate at an acute angle. For the most part blood-sucking flies; mosquitoes. . . . . **Culicidæ**, 96

Wings bare; the third vein arises from the second near the middle of the wing, apparently continuous, the second vein arching suddenly forward; never blood-sucking in habit. **Dixidæ**, 94

12. Wings with a spider-web-like secondary venation. **Blepharoceridæ**, 148

Wings not with such secondary venation. 13

13. Coxæ much elongate (moderately so in the Sciarinæ); antennæ usually elongate, the joints usually with constrictions between them; three or two ocelli present; in the latter case one situated near each eye and sometimes perceptible with difficulty; rarely the ocelli appear to be entirely absent; no sexual holopticism; all the tibiæ spurred; second basal cell never complete. **Mycetophilidæ**, 131

Coxæ short; the thorax not strongly arched above; antennæ usually shorter than the thorax and closely jointed without marked constrictions, sometimes 14-16 jointed, longer and slender; legs usually strong, the pulvilli usually present (Bibioninæ); eyes of male often large and holoptic; second basal cell often complete. . . . . **Bibionidæ**, 140

AA. BRACHYCERA.

Anal cell closed before the border of the wing or distinctly narrowed in the border; if absent or very short the antennæ are composed of two or three simple joints with or without a style or arista. Palpi rarely elongated, never with more than one freely articulated joint, that is two-jointed or one-jointed or absent. Antennæ: (a) *elongate, composed of distinctly separable joints, the joints of the flagellum homomorphous and sometimes as many as thirty in number;* (b) *composed of not more than ten closely united joints without style;* (c) *the so-called third joint is complex, that is, composed of from four to eight segments or annuli, the distal one or ones usually differ-*

entiated into a style or arista; (d) *composed of three simple joints (sometimes apparently two), with or without a differentiated, one to three-jointed, style or arista. Second vein of the wing never furcate, the third often; discal cell almost always present.*

14. Antennæ composed of two or three simple joints, the distal one not annulated nor segmentated, usually with a one to three-jointed terminal or dorsal arista or terminal style (d), . 18
Antennæ of the structure of (a), (b), or (c). . . . 15

15. Empodia undeveloped or bristle-like; antennæ elongate, the flagellum composed of two or three joints, without apparent style; front concave between the eyes in both sexes. . . . 25
Empodia developed pulvilliform; flagellum of antennæ with numerous, distinct joints, or forming the complex, so-called third joint, with or without a differentiated style or bristle; body not bristly. 16

B. *Antennæ composed of more than five joints, or the third-joint complex, four to eight segmented, inclusive of style or arista when present:*

16. Squamæ rather large; third longitudinal vein furcate; five posterior cells always present; the costal vein encompasses the wing; flagellum composed of from four to eight segments, never with style or arista; males holoptic; proboscis of female adapted for piercing. Horseflies, gadflies, greenheaded flies.
Tabanidæ, 176
Squamæ small or vestigial; for the most part flower flies; males usually holoptic. 17

17. Tibiæ without spurs; wing veins not crowded anteriorly; third antennal joint composed of seven annuli with a terminal slender style or arista; two submarginal, five posterior cells always present, the fourth closed. Very large, robust, southern flies.
Acanthomeridæ, 173
Tibiæ almost invariably without spurs; longitudinal veins of the wings usually more or less crowded anteriorly, the posterior ones often weak; the costal vein does not reach beyond the tip of the wing; scutellum often with spines; third vein almost always furcate; four or five posterior cells, the fourth rarely or never closed; antennæ long or short (b), (c).
Stratiomyidæ, 164
The middle tibiæ, at least, with distinct spurs; the costal vein en-

compasses the wing; third vein always furcate; five posterior cells present, the posterior veins not evanescent; antennæ (a), (b), (c). . . . . , . **Leptidæ**, pt. 157

BB. *Third joint of antennæ simple, not composed of annuli, with or without a differentiated style or arista.*

18. Antennæ apparently two-jointed, with a three-jointed arista; wings (rarely wanting) with several stout veins anteriorly and other, weaker ones apparently connected with them and running obliquely across the wing. Femora flattened, the hind ones elongated; antennæ situated low down. Small, hunchbacked, quick running, bristly flies. . . . . **Phoridæ**, 236

Not such flies, the antennæ almost invariably with three easily distinguishable joints. 19

19. Empodia developed pulvilliform, that is three nearly equal, membranous appendages on the under side of the claws. . 20

Empodia wanting, vestigial or linear, not developed like the pulvilli. 22

20. Squamæ very large; thorax and abdomen inflated; head small, eyes relatively large; antennæ and venation variable. **Cyrtidæ**, 182

Squamæ of moderate size, or small. 21

21. Middle tibiæ at least with spurs; no bristles on femora or tibiæ; third vein furcate; five posterior cells present (four sometimes in *Dialysis* and *Misgomyia*); anterior cross-vein always distinct; third joint of antennæ with a bristle or slender style, usually terminal. **Leptidæ**, pt. 157

Venation intricate, the third and fourth veins often coalescent for a short distance; tibiæ without spurs; antennæ with a slender, three-jointed style; usually hairy. . **Nemestrinidæ**, 186

22. Third longitudinal vein furcate; two or more submarginal cells present. 23

Third vein not furcate, but one submarginal cell. . . 31

23. Arista or style of antennæ always terminal when present. 24

Arista dorsal. . . . . **Empididæ**, pt. 218

24. Front distinctly hollowed out between the eyes; eyes of males never contiguous; basal cells large; mostly large flies. . 25

Front plane or convex; males often holoptic. , . . 26

25. Proboscis with fleshy labella at tip; venation complicated, the fourth vein curves forward to terminate before the tip of the

wing; palpi small or wanting. Large to very large, bristleless flies. . . . . **Mydaidæ**, 190

Proboscis without fleshy labella at tip, horny and rigid; five posterior cells almost always present; palpi usually prominent. Mostly large, bristly, predaceous flies. . **Asilidæ**, 192

26. Five posterior cells in the wing; basal cells large. . . 27
Not more than four posterior cells.* 29

27. Venation intricate; empodia and pulvilli membranous, but frequently minute (see 21)..
Venation not intricate, the anterior cross-vein always apparent. 28

28. The fourth vein terminates before tip of wing; male sexual organs prominent; males dichoptic. . . . **Apioceridæ**, 188
The fourth vein terminates beyond the tip of the wing; male sexual organs small; males often holoptic. . **Therevidæ**, 205

29. Third antennal joint without bristle or style; three posterior cells, the first narrowed or closed; the fourth vein terminating at or before the tip of the wing. . . . **Scenopinidæ**, 208
Third antennal joint usually with a terminal style; four or three posterior cells; the fourth vein terminates beyond tip of wing. 30

30. Anal cell narrowly open or closed near border of wing (if discal cell wanting, see *Hilarimorpha* p. 157, footnote). **Bombyliidæ**, 210
Anal cell closed remote from border, sometimes absent; discal cell not rarely absent. . . . . **Empididæ**, 218

31. Wings pointed; no cross-veins, save at base; second basal cell short; arista terminal; small flies. . **Lonchopteridæ**, 240
Wings not lanceolate. 32

32. Anal cell elongate, acute, closed toward or near the border of the wing; second basal cell usually long. 36
Anal cell, if present, short, closed remote from the border of the wing, not acutely produced (rarely produced in a narrow, lobe-like prolongation.) 33

33. Second basal cell confluent with discal cell, or the discal cell absent; auxiliary vein usually vestigial or indistinct; anal cell often absent; usually small flies. 34
Second basal cell separated by a cross-vein from a complete discal cell; auxiliary vein and anal cell usually complete. . 40

* Five in a very few species of Bombyliidæ.

34. For the most part brilliantly colored, predaceous flies; face of male usually narrower than that of female; arista dorsal or terminal; hypopygium often enlarged or conspicuous.
Dolichopodidæ, 228

Not brilliantly colored, predaceous flies. 35

35. Eyes sometimes contiguous; head small, the proboscis usually rigid; arista usually terminal. . . **Empididæ**, pt. 218

Eyes never contiguous; proboscis not rigid; arista almost always dorsal. 42

CYCLORRHAPHA.

A frontal lunule above the base of the antennæ; third antennal joint always simple, not annulated or complex, with a terminal or dorsal arista, rarely with a terminal style; third vein never furcate; never more than three complete posterior cells present. Empodia never pulvilliform.

36. Between the third and fourth longitudinal veins and subparallel with them a spurious longitudinal vein; or, when rarely absent, the first posterior cell is closed remote from the border; first posterior cell always closed; head never with bristles, which are rarely present elsewhere; males usually holoptic; almost always with a dorsal arista, rarely a terminal style. Usually brightly colored flower flies. . . . . **Syrphidæ**, 246

No spurious longitudinal vein. 37

37. Front broad in both sexes; antennæ with a terminal style or dorsal arista; face usually with grooves below the antennæ; proboscis elongate and slender, often folding; no bristles anywhere (*Conopidæ*, 261.)

Not such flies; bristles almost invariably present. . . 38

38. Hind metatarsi enlarged and ornamented, especially in the males, males holoptic; arista terminal. . . **Platypezidæ**, 241

Hind metatarsi not enlarged nor ornamented. . . . 39

39. Head large, composed chiefly of the eyes, the front in the males narrowed or the eyes contiguous; first posterior cell narrowed; arista dorsal; rather small flies. . . **Pipunculidæ**, 244

Head not large, subspherical, the front broad in both sexes, proboscis short, not rigid; first posterior cell narrowed; legs elongated (*Micropezidæ* pt. 264).

Head small, the front narrowed or eyes contiguous in male; first posterior cell wide open (*Empididæ*, pt. 218).

40. Head small; proboscis more or less elongated; alula of wings usually vestigial (*Empididæ*, pt. 218).
Head not unusually small; proboscis rarely elongated; arista almost invariably dorsal. 41

A. MYODARIA.

Never more than three posterior cells present, the first of which only may be closed or narrowed in the margin; none of the longitudinal veins furcate; marginal and submarginal cells never closed; anal cell very rarely produced toward the margin of the wing (*Micropezidæ pt. Ortalididæ, pt. etc.*) *Antennæ three-jointed, simple, with a bare, pubescent, pectinate or plumose arista, which is almost always dorsal in position, never thickened into a terminal style. More or less bristly flies.*

41. Squamæ large; front of male narrowed or eyes contiguous. 59
Squamæ small; eyes of male not more approximated than those of female, or if so the narrowing is due to the diminished width of the median stripe, the borders remaining the same, the males never holoptic; posterior callus of thorax almost always not distinct. 42

B. *ACALYPTERÆ.*

Squamæ always small or vestigial. Auxiliary vein often indistinct or vestigial, or closely approximated or fused with the first vein. First longitudinal vein shortened, often very short. Basal cells small, the posterior ones often indistinct or wanting. Males never holoptic, the front in this sex never markedly narrowed. Thorax without complete transverse suture; posterior callosity usually absent. Never large flies, usually small or very small.

42. Auxiliary vein present, separated from first longitudinal vein and terminating distinctly in the costa; the first vein usually ends near or beyond the middle of the wing; posterior basal cells present. 43
Auxiliary vein absent, vestigial or incomplete; the first vein usually ends in the costa before the middle of the wing. . 49

43. A distinct bristle on each side of the face near the oral margin, i. e. oral vibrissæ present. 44
No oral vibrissæ. 45

44. Mesonotum and scutellum flat; front bristly; cheeks and face bristly; all the tibiæ spurred and with preapical bristle; seashore flies. . . . . **Phycodromidæ**, 317
Mesonotum not flattened, convex; no costal spine; more than four abdominal segments visible. . **Cordyluridæ**, 327

Wings elongate, the cross-veins often approximated; post-vertical bristles divergent; front bristly; smaller, somewhat elongate flies; sixth and first veins short. . **Heteroneuridæ**, 318

Front never bristly near the antennæ; abdomen somewhat elongate, cylindrical, usually narrowed near base. Small, black flies about decaying matter. . . . . **Sepsidæ**, 269

Costa almost always pectinate; tibiæ with spurs and preapical bristles; not very small flies. . . **Helomyzidæ**, 324

45. Femora thickened; hind tibiæ usually dilated; basal cells not very small; first posterior cell narrowed; all the tibiæ with preapical bristle. Moderate sized, bare, southern flies.

Rhopalomeridæ, 280

Not such flies. 46

46. First posterior cell closed or narrowed in the margin; abdomen elongate; legs long or very long. 47

Not such flies. 48

47. Eyes large, the cheeks and posterior orbits narrow, the occiput concave:

Proboscis short; ovipositor not elongate. **Tanypezidæ**, 264

Proboscis greatly elongate and folding near its middle; ovipositor very long. . . . . **Conopidæ**, pt. 261

Head subspherical, the cheeks broad and face retreating; proboscis short. . . . . **Micropezidæ**, 264

48. One or two fronto-orbital bristles; preapical bristle absent or present; wings sometimes pictured; anal cell always rounded distally.

Sapromyzidæ, 288

Upper fronto-orbital bristles, only, present; ovipositor horny, more or less elongate; anal cell often acute distally, or drawn out into a narrow, acute lobe; arista seldom plumose; no preapical bristle (except *Automola*); wings almost invariably pictured.

Ortalididæ, 272

Fronto-orbital bristles present* or absent; second joint of antennæ often elongated; postvertical bristles divergent; a preapical bristle; ovipositor not horny; wings often pictured. Meadow flies. . . . . **Sciomyzidæ**, 321

49. Head produced on each side into a lateral process for the eye; basal cell confluent with discal cell. . . **Diopsidæ**, 314

Head not produced into lateral processes. 50

* If small, greenish black flies of the sea-coast, with globular third antennal joint, compare *Canace* (Ephydridæ).

50. Hind metatarsi incrassate and usually shorter than the second joint; oral vibrissæ present; second basal cell distinct or not; about excrement or near water. . . **Borboridæ**, 315

Hind metatarsi not incrassate and always longer than the following joint. 51

51. Discal and basal cells united, the separating cross-vein vestigial or absent. 52

Discal and second basal cells separated. 54

52. Anal cell absent. 53

Anal cell complete, though often small. 54

53. Front bare, or at the most bristly above; small, usually light colored flies. . . . . **Oscinidæ**, 310

Front often bristly; mouth cavity usually large; no oral vibrissæ; rather small to very small black or dark-colored flies about water. **Ephydridæ**, 303

54. Scutellum elongate, triangular; with spines or protuberances on its margin; femora thickened. . **Rhopalomeridæ**, 280

Flies not having all the above characters. 55

55. Oral vibrissæ present. 56

No oral vibrissæ. 58

56. Arista long plumose, or pectinate above. **Drosophilidæ**, 299

Arista bare, pubescent or short plumose. 57

57. Front bare or bristly at vertex only; small, black flies, with narrow, usually contracted abdomen. . . **Sepsidæ**, 269

Front bristly at least as far as the middle; often light colored, small or very small flies. **Agromyzidæ**, 291; **Geomyzidæ**, 297

58. The auxiliary vein is evanescent at its tip, where it turns sharply forward at some distance before the tip of the first vein; wings almost always pictured; anal cell angular, or drawn out into a narrow acute lobe; no preapical tibial bristle. **Trypetidæ**, 282

Auxiliary vein more or less fused with the first vein; antennæ more or less elongate and decumbent; anal cell not produced; rather small, elongate flies. **Psilidæ**, 267

Posterior basal and anal cells very small; wings rarely pictured. Small or very small, often silvery gray or whitish gray species. **Geomyzidæ**, 297

BB. *CALYPTERÆ.*

Squamæ well developed or of moderate size, not vestigial. Auxiliary vein always distinct in its whole course; first longitudinal vein never very short, usually of considerable length. Males often holoptic, or the front in that sex narrowed. Thorax with complete transverse suture; posterior callosity present. Usually flies of moderate or considerable size, never very small.

59. Oral opening small, the mouthparts small or vestigial; first posterior cell closed or narrowed (except *Gastrophilus*). Bot flies. **Oestridæ**, 344

Oral opening of usual size, the mouthparts not vestigial. 60

60. Hypopleuræ with a tuft of bristles; first posterior cell narrowed or closed. 61

Hypopleuræ not with tuft of bristles; first posterior cell narrowed or fully open in the margin. 64

61. Antennal bristle bare or somewhat pubescent. **Tachinidæ**, 358

Antennal arista plumose or very distinctly pubescent. . 62

62. Arista bare on the distal half; dorsum of abdomen rarely bristly on anterior part. . . . . **Sarcophagidæ**, 348

Arista plumose or distinctly pubescent to tip. . . . 63

63. Dorsum of abdomen usually bristly on anterior part; legs usually long. . . . . **Dexiidæ**, 352

Abdominal segments without bristles, save more or less near the tip; legs not noticeably elongated (Calliphorinæ). **Muscidæ**, 337

64. First posterior cell narrowed or closed; arista plumose to tip. **Muscidæ**, pt. 337

First posterior cell very slightly or not at all narrowed in the margin; arista plumose, pubescent or bare. **Anthomyidæ**, 331

AA. PUPIPARA.

65. Wingless flies, parasitic upon bats; head folding back on the dorsum of the thorax. . . . . **Nycteribiidæ**, 386

Winged or wingless flies, parasitic upon birds or mammals; head not folding back upon dorsum or thorax. . . . 66

66. Antennæ reduced; wings with distinct parallel veins and outer cross-veins when present; claws simple; palpi leaf-like, projecting in front of the head; almost exclusively parasitic upon bats. **Streblidæ**, 384

Antennæ usually more elongate, the joints more or less distinctly separated; head sunk into an emargination of the thorax; wings, when present, with veins more or less crowded anteriorly, the weaker ones running outward and backward, the cross-veins short and approximated to the base of the wing; claws large, bidentate or tridentate; palpi not leaf-like nor protruding in front of the head. . . . . **Hippoboscidæ**, 382

MYODARIA.

The very large group of flies, called here the Myodaria, after Desvoidy, and very commonly known in the past as the Muscidæ, sens. lat, has been divided into many lesser groups by students of the order. The number and limitations of these groups are the subjects of most divergent opinions, no two writers agreeing. I have, in general, followed the opinions of Loew and Schiner where I had none of my own, with some suggestions from Czerny and Hendel. In deference to common usage I give the family termination to the names of the groups adopted, not because I believe that they are of equivalent rank to the families, as generally accepted, of the Cyclorrhapha, for I most emphatically do not, but because of common vogue. It really matters little what they are called, so long as it is distinctly remembered that they have in general less morphological significance. The only danger is that the other families may be broken up into countless groups of equivalent rank, a result to be deplored and which would serve no useful purpose.

The family, or superfamily, whatever it be, includes more than a half, perhaps, of all living diptera. They, and especially the Calypteræ, are the dominant diptera of the present time, the latest and most highly specialized types of the order. And it is because of this dominance that they are exceedingly hard to classify clearly and distinctly. Nor will their classification approach a much more satisfactory equilibrium until more of the world's fauna is known, especially in view of the fact that the smaller forms in particular have been, in general, largely neglected by competent students as the proletariat of the order.

That the group is a difficult one, even for the expert, is only too true. Full descriptions and figures are almost indispensable in many, if not most cases for allaying doubt as to genera, especially in the present chaotic condition of the nomenclature of the Calypteræ. I have used the more commonly employed distinctions for the 'families' of the Calypteræ, and there can be no question but that these, oftentimes trivial, characters do, for the most part, define natural groups, but not in all cases, and the student must find for himself the divergent, anomalous, or homoplastic forms. And, as a general rule in taxonomy, he should remember that differences are of more importance than resemblances in defining relations. That we shall discover more natural characters for their definition soon is without doubt, but, until specialists come to some fairly general agreement as to what these characters are, we must continue to use those which bring together the great majority of the forms into genetic groups.

Czerny and Hendel place much importance on the direction of the postvertical bristles in the arrangement of the Acalypteræ, and I am disposed to admit the justice of their claim in large measure. According to these authors these bristles are convergent in the Helomyzidæ, Sapromyzidæ, Drosophilidæ, Geomyzidæ, Milichinæ and Ochthiphilinæ; erect in the Trypetidæ; divergent in the Cordyluridæ, Heteroneuridæ, Ortalididæ, Micropezidæ, Sciomyzidæ, Sepsidæ and Lonchæidæ, as these authors accept these families.

Upon the cruciate bristles of the front they also place not a little weight, as present more or less in the Anthomyidæ, Heteroneuridæ, Ephydridæ, etc. It must be remembered, however, that all these bristles are usually minute, often exceedingly so; or absent in forms closely related otherwise to those having them well developed;

and they are often difficult of discernment. I am not disposed to place a large degree of reliance upon characters so inconstant.

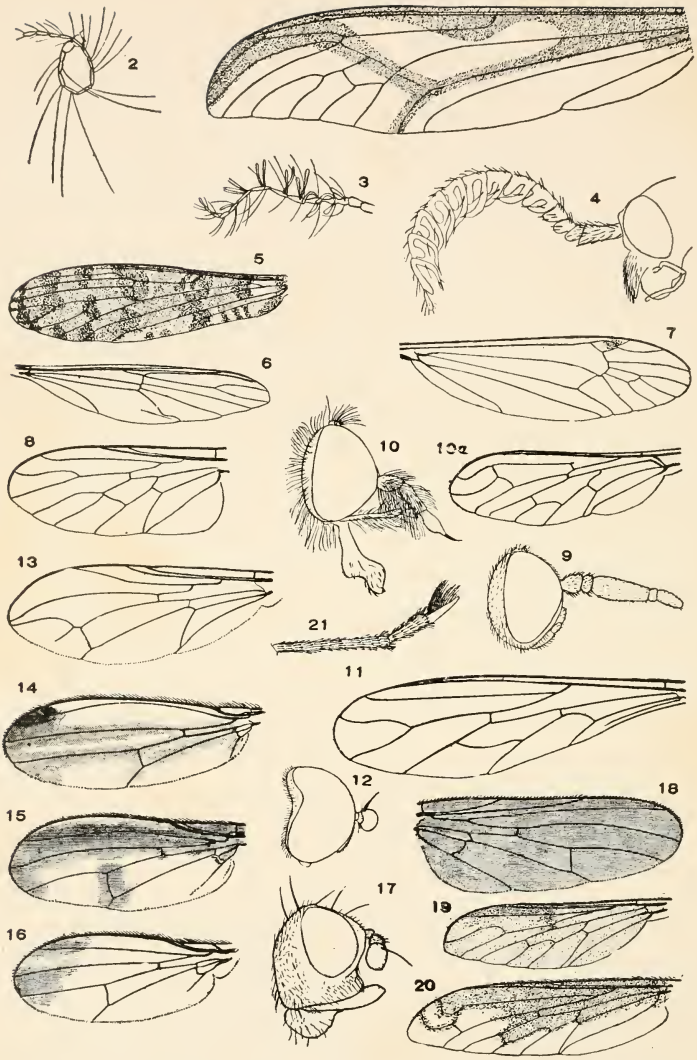
It will be observed that, as in the former edition, I follow Schiner in arranging the Myodaria in a reverse order from that usually given in systematic works and catalogues. In the holoptic eyes, enlarged squamæ, greater development of the bristles, entire absence of apical arista, and larger size, the Calypteræ demonstrate their high rank among the Cyclorrhapha; and they of course could not have been the ancestral type from which the Acalypteræ arose. The Acalypteræ are for the most part a divergent branch with certain decadent specializations like those of the oligoneurous Nemocera. The relationships between the Tanypezidæ or Micropezidæ and certain forms which by common consent are placed among the Conopidæ, are beyond all dispute; indeed in my opinion the Conopidæ should be included among the Myodaria, as they were by Desvoidy.

PUPIPARA.

The singular group of flies known as the Pupipara or Eproboscidea is composed wholly of ectoparasites infesting mammals, birds and other insects, living among the hair or feathers of their hosts and subsisting upon their juices. This parasitic habit has induced many remarkable modifications of structure, as would be supposed. The compound eyes are never large, and, in those flies living upon the crepuscular or nocturnal bats, they have become reduced to the merest vestiges. So, also, the ocelli are in general degenerate and often wanting. The antennæ are short, the joints often apparently reduced in number, and they are often bristly. The mouth-parts, while still retaining all the constituent parts of most other diptera, have become much abbreviated, and are not

at all retractile. The body is more or less flat, the abdomen indistinctly segmentated in most cases and leathery in appearance. The legs are always stout, sometimes much elongated, with strong and stout claws, which may have an strong pectination in addition to the enlarged basal part. In their breeding habits all are believed to be pupiparous, that is giving birth, not to eggs or even young larvæ, as is the case with nearly all other diptera, but to larvæ just ready to transform into puparia, an evident adaptation to their peculiar enviromental conditions. The wings, as would be supposed, are often vestigial or wanting, and in many cases the venation has undergone degeneration. But a single form is known to be parasitic upon other insects, bees, of a family hitherto unknown to occur in America.

Because of these marked and peculiar habits, and the structural characters, some recent writers are inclined to raise the rank of the group to a subordinal value, making it equivalent to all the other diptera combined. To this, however, I am decidedly opposed. The flies seem, with hardly a doubt, to be merely degenerate descendants of the Muscids, and probably of the acalyterate division. The venation of such forms as *Raymondia* is characteristically acalypterate; in some others there has been, apparently, an elongation of the first and sixth veins, and an enlargement of the basal cells. Schiner long ago described a peculiar type with reduced wings, parasitic upon hawks, which he placed among the acalypterates in the vicinity of the Borboridæ, and it does not seem unlikely that this is the real relationship of the whole group. Very similar structural adaptations are observed among the parasitic and wholly unrelated Phoridæ—bristly, reduced antennæ, loss of eyes and wings, leathery abdomen, stout legs, etc.; or among the tsetse flies—distinctly pupiparous habits. The most that I am willing to concede to the Pupipara is a rank equivalent to that of the Myodaria. The group is a comparatively recent one geologically, in all probability.



1, *Pedicia;* 2, *Atarba pleuralis;* 3, *Rhipidia costalis;* 4, *Ctenophora;* 5, *Epiphragma sackeni;* 6, *Bittacomorpha clavipes;* 7, *Pachyrhina;* 8, 9, *Desmatomyia anomala* (type); 10, *Aldrichia ehrmanni;* 11, *Dolichomyia gracilis* (type); 12, 13, *Nephrocerus* (Penna.); 14, *Ischnomyia;* 15, *Palloptera jucunda;* 16, *Clusia;* 17, 18, *Heterocheila;* 19, *Eclimis;* 20, 21, *Lepidophora vetusta.*

I. Family TIPULIDÆ.

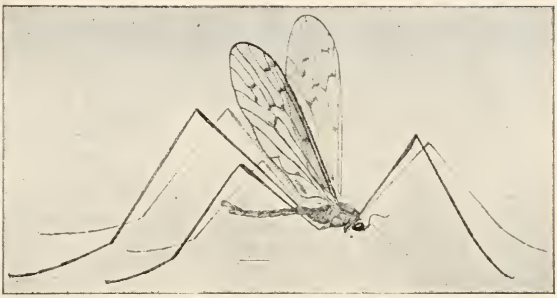


Fig. 23. *Helobia hybrida*, enlarged. After Washburn.

Large to moderately small, slender flies, with long, slender legs. Head subspherical; occiput strongly developed; face often produced snout-like. Eyes round, separated by the broad front; sometimes approximated above and below the antennæ, but never contiguous. Ocelli almost always *(Trichocera)* wanting. Antennæ rarely shorter, usually longer than the head and thorax together; bead or thread-like, composed of from six *(Anisomera)* to thirty-nine *(Cerozodia*)* joints, the joints of the flagellum never plumose, but usually with more or less conspicuous bristly hairs; the joints sometimes serrated or pectinated; usually there are eleven, twelve or fourteen joints in the flagellum. Proboscis more or less projecting, in a few genera very much elongated; palpi four or five jointed, the terminal joint often elon-

* This genus, from Australia, has, according to Osten Sacken, from twenty-nine to thirty-seven joints in the flagellum, all of which, except the terminal one or ones, are branched.

gated, whiplash-like. Thorax convex above, with a very distinct suture in the form of a shallow V, except in the Ptychopterinæ; prothorax usually distinct, collar-like; scutellum half-round; metanotum strongly developed. Abdomen cylindrical, composed of seven or eight joints; genitalia prominent, in the male very variable in structure; in the female, the ovipositor (save rarely) has two pairs of long, horny, pointed valves. Legs very long and slender; the tibiæ sometimes with terminal spurs.

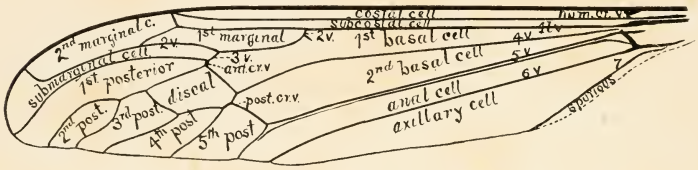


Fig. 24. Venation.

Wings long, but comparatively narrow; in rest spread apart or lying parallel over the abdomen; auxiliary vein present; always six longitudinal veins; usually a complete discal cell; both basal cells long; the anal cell usually widely open; seventh vein usually distinct (save in the Ptychopterinæ) and of variable form; axillary lobe rounded, rarely angular.

The family Tipulidæ comprises the largest of the nematocerous flies, some of which exceed two inches in length. The abdomen is always elongate. The legs are very long and delicate—so delicate indeed that one seldom succeeds in capturing the insects without the loss of one or more. Flies of this description with a distinctly impressed V-shaped 'suture' on the mesonotum will be immediately recognized as belonging to this family. The females differ from those of most other flies in having the ovipositor adapted for the deposition of their eggs in the ground or other firm substances. When the weather is

favorable the eggs hatch in a little more than a week. The larvæ are ash-gray or brownish in color, more or less transparent, composed of twelve segments. The head is incompletely differentiated and retractile, and has the maxillæ and mandibles more or less horny and stout; there are short fleshy antennæ in most larvæ, but are long and two-jointed in the Tipulinæ. The organs of locomotion generally consist of transverse swellings on the under side of the body, provided with very minute, stiff bristles. The anal end of the body is truncate, with a single pair of spiracles; and the margins of the truncature are for the most part provided with fleshy, retractile processes of variable size and shape. Some aquatic larvæ have a long tube at the end of the body, which serves for respiration when raised to the surface of the water.

Most of the larvæ live in the earth or in soil-like, decomposing wood, in fungi, or in water. Others live on the leaves of plants and are like caterpillars in appearance, the resemblance to which is yet more heightened by the green color, with a crest of tubercles on the back.

The pupæ, like those of many of the members of this suborder, are free. The thorax has two horn-like processes which represent the thoracic spiracles, one of which may acquire a very great length for the purpose of breathing from the surface while under water. The abdominal segments have transverse rows of hairs, bristles or spines, which enable the pupa to escape from its place of concealment when about to complete its metamorphosis.

The adult flies are often seen in the late summer and autumn. They will be most usually met with in meadow-lands and forests, flying awkwardly for a few steps, close to the ground till they become entangled in the grass or twigs, and then extricating themselves, rising again to repeat the same aimless, clumsy flight.

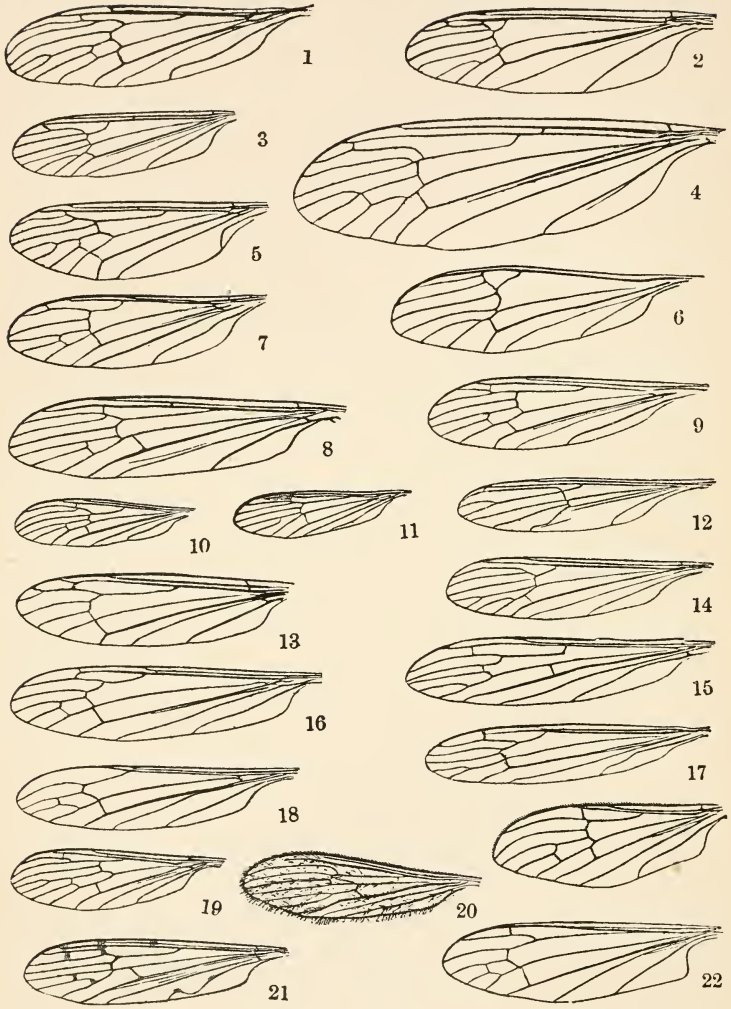


Fig. 25. Tipulidæ. 1, *Limophila luteipennis;* 2, *Dicranota rivularis;* 3, *Plectromyia modesta;* 4, *Amalopis calcar;* 5, *Trichocera bimacula;* 6, *Cryptolabis paradoxa;* 7, *Goniomyia sulphurella;* 8,

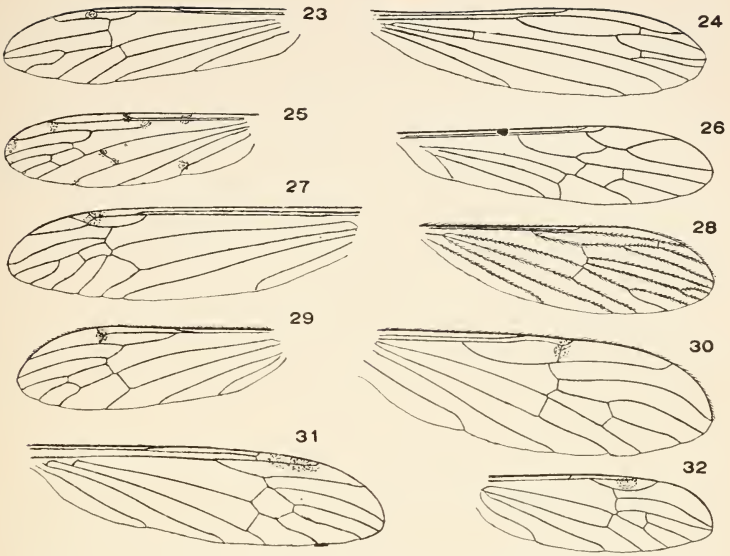


Fig. 26. Tipulidæ. 23, *Elliptera*, sp.; 24, *Diotrepha mirabilis;* 25, *Rhipidia subpectinata;* 26, *Mongoma pallida;* 27, *Tipula subinfuscata;* 28, *Polymera albitarsis;* 29, *Geranomyia pallida;* 30, *Teucholabis complexa;* 31, *Rhamphidia albitarsis;* 32, *Atarba pleuralis.*

The name of 'daddy-long-legs' is the one usually applied to members of this family in England, but in America this term is generally used to designate the Phalangidæ or harvest spiders. The name 'crane-flies' is preferable. Commonly they are harmless, but some of the species in the larval state are very destructive, feeding upon the tender rootlets of grass and grain, and causing the plants over large surfaces to wither and die. There are about twelve hundred species known.

Trimicra pilipes; 9, *Limnophila quadrata;* 10, *Gnophomyia tristissima;* 11, *Rhypholophus rubellus;* 12, *Bittacomorpha clavipes;* 13, *Anisomera neglecta;* 14, *Rhaphidolabis tenuipes;* 15, *Orimarga alpina;* 16, *Dicranomyia heretica;* 17, *Dicranomyia longipennis;* 18, *Toxorhina magna;* 19, *Limnophila areolata;* 20, *Erioptera*, sp.; 21, *Helobia punctipennis;* 22, *Antocha opalizans.* After Osten Sacken.

In this family are placed several wingless forms, or those with the wings more or less rudimentary. One of the former is *Chionea*, the species of which are found on snow, often in the coldest weather.

The family Tipulidæ is easily divided into three subfamilies, which I prefer to call the Ptychopterinæ, Limnobiinæ and Tipulinæ, and which correspond precisely with the Ptychopterina, Tipulidæ brevipalpi and Tipulidæ longipalpi of Osten Sacken.

The following table is chiefly based upon that of Osten Sacken in his monograph, which will be indispensable to the student. The nomenclature of the venation is that of Osten Sacken.

TABLE OF GENERA.

1. Seventh longitudinal vein present, that is there are two longitudinal veins between the fifth vein and the posterior margin of the wing. 2
   Seventh longitudinal vein absent; no distinct V-shaped suture on mesonotum. . . . . **Ptychopterinæ.**

2. Last joint of the palpi shorter or not much longer than the two preceding together; the auxiliary vein usually ends in the costa and is connected with the first longitudinal vein by a distinct cross-vein; antennæ six to sixteen jointed, rarely more. **Limnobiinæ**
   Last joint of the palpi whiplash-like, much longer than the three preceding together; antennæ rarely with more than thirteen joints; the auxiliary vein ends in the first longitudinal vein by an abrupt curvature at the tip, not connected with the first vein by a cross-vein. . . . . **Tipulinæ.**

LIMNOBIINÆ.

1. Wingless, spider-like in appearance. . . . **Chionea.**
   Winged. 2

2. A single submarginal cell present. 3
   Two submarginal cells present (one in *Goniomyia manca.*) . 5

3. Antennæ 14-jointed. . . . . **Limnobiini.**
   Antennæ 16-jointed. 4

4. Tibiæ with spurs at the tip; the first longitudinal vein usually ends in the second. . . . . **Cylindrotomini.**
Tibiæ without spurs; the first vein ends in the costa. **Antochini.**

5. Tibiæ without spurs at the tip. . . . . **Eriopterini.**
Tibiæ with spurs at the tip. 6

6. The subcostal cross-vein is beyond the origin of the second longitudinal vein. 7
The subcostal cross-vein is before the origin of the second longitudinal vein. . . . . **Amalopini.**

7. Antennæ composed of sixteen joints. . . **Limnophilini.**
Antennæ composed of from six to ten joints, often much elongated. **Anisomerini.**

LIMNOBIINI.

1. Proboscis longer than the head and thorax together (29). **Geranomyia.**
Proboscis shorter than the head and thorax together. . . . 2

2. Antennæ pectinate or subpectinate, at least, in the male (25, p. 80.3) **Rhipidia.**
Antennæ not pectinate. 3

3. A supernumerary cross-vein between the sixth and seventh veins. **Discobola.**
No cross-vein connecting the sixth and seventh veins. . . 4

4. Tip of the auxiliary vein usually opposite, or before, or only a short distance beyond the origin of the second vein; marginal cross-vein always at the tip of the first longitudinal vein; legs slender. **Dicranomyia.**
Tip of the auxiliary vein usually far beyond the origin of the second vein; marginal cross-vein sometimes at the tip but often some distance before the tip of the first vein; legs comparatively stout. **Limnobia.**

ANTOCHINI.

1. Rostrum at least as long as the head, sometimes very long; no marginal cross-vein. 2
Rostrum shorter than the head. 4

2. Wings without submarginal cell (18). . . . **Toxorhina.**
Wings with submarginal cell. 3

3. Rostrum not much longer than the head (31). **Rhamphidia.**
Rostrum the length of the body. . . . **Elephantomyia.**

4. Discal cell open. 5
Discal cell closed. 7

5. Second basal cell considerably shorter than the first. . . 6
Second basal cell of about the same length as the first (23). Elliptera.

6. Three posterior cells; the great cross-vein more proximal than the origin of the second vein (24). . . . Diotrepha.
Four posterior cells; the great cross-vein more distant than the origin of the second vein, ... Orimarga.

7. No marginal cross-vein whatever (32, p. 80, 2). . . Atarba.
Marginal cross-vein present. 8

8. The first longitudinal vein ends in the costa nearly opposite the inner end of the submarginal cell. 9
The first vein ends in the costa far beyond the inner end of the submarginal cell. . . . . Dicranoptycha.

9. Submarginal cell as long or but little longer than the first posterior cell (30). . . . . Teucholabis.
Submarginal cell much longer than the first posterior cell (22). Antocha.

ERIOPTERINI.

1. Five posterior cells; male antennæ not peculiar. . Cladura.
Five posterior cells; joints of the male flagellum binodose, forming apparently twenty-eight joints in the antennæ (25 also fig. 5, 1, page 27, ♀). . . . . Polymera.
Four posterior cells. 2

2. The inner marginal cell has almost the shape of an equilateral triangle (6). . . . . Cryptolabis.
Inner marginal cell of the usual shape. 3

3. Wings conspicuously hairy on the whole surface or along the veins. 4
Wings not conspicuously hairy, veins bare or nearly so. . 7

4. Antennal joints subreniform and nodose; eyes nearly contiguous above and below. . . . . Sigmatomera.
Species not having the foregoing characters. . . . 5

5. Wings hairy on the whole surface (11). . Rhypholophus.
Wings hairy along the veins only. 6

6. Second submarginal cell longer than the first (20). Erioptera.
First submarginal cell longer than the second. Molophilus.

7. First submarginal cell short, not more than half the length of the second. 8
First submarginal cell more than half the length of the second. 11

8. Marginal cross-vein present. 9
Marginal cross-vein absent (7). . . . . **Goniomyia.**

9. Second submarginal cell in contact with the discal cell, the anterior cross-vein obsolete. 10
Anterior cross-vein present, the first posterior cell intervening between the submarginal and the discal cells. . **Empeda.**

10. Seventh longitudinal vein very short; no empodia (26). **Mongoma.**
Seventh longitudinal vein not unusually short; empodia present. **Paratropesa.**

11. Seventh longitudinal vein conspicuously bisinuate (21). **Helobia.**
Seventh longitudinal vein straight. 12

12. Length of the auxiliary vein beyond the cross-vein at least twice that of the posterior or great cross-vein (8). . **Trimicra.**
The cross-vein situated near the end of the auxiliary vein (10). **Gnophomyia.**

LIMNOPHILINI.

1. Discal cell open; antennæ apparently 28-jointed in the ♂ (28). **Polmera.**
Discal cell closed. 2

2. Marginal cross-vein wanting. . . . . **Phyllolabis.**
Marginal cross-vein present. 3

3. Wings pubescent, ... **Ulomorpha.**
Wings bare. 4

4. Seventh vein very short, abruptly incurved toward the anal angle (5). . . . . **Trichocera.**
Seventh vein not unusual. 5

5. A supernumerary cross-vein between the auxiliary vein and the costa (p. 80, 5). . . . . **Epiphragma.**
No such supernumerary cross-vein (1, 9, 19)*. **Limnophila.**

* A wingless form has recently been referred to this genus, with doubt, by Mr. Coquillett.

ANISOMERINI.

1. Three posterior cells; two submarginal cells (13). **Anisomera.**
   Four or five posterior cells; antennæ of the ♂ sometimes much elongated. 2

2. The stigma occupies nearly the whole space between the tip of the auxiliary vein and the marginal cross-vein. . **Eriocera.**
   The stigma occupies but a small portion of the space between the tip of the auxiliary vein and marginal cross-vein. **Penthoptera.**

AMALOPINI.

1. Antennæ composed of thirteen joints 2
   Antennæ composed of sixteen or seventeen joints. . . 5

2. Two cross-veins between the first longitudinal vein and the anterior branch of the second vein. 3
   Only one cross-vein between these veins. 4

3. Front with a gibbosity behind the antennæ (2). . **Dicranota.**
   Front without gibbosity. . . . . **Polyangæus.**

4. Five posterior cells; both branches of the fourth vein furcate (14). **Rhaphidolabis.**
   Four posterior cells; the posterior branch furcate. **Plectromyia.**

5. Four posterior cells; wings pubescent. . . . . **Ula.**
   Five posterior cells; wings bare. 6

6. Anterior cross-vein nearly at right angles with the longitudinal axis of the wing. 7
   Anterior cross-vein at a very oblique angle with the longitudinal axis of the wing, and parallel with the posterior cross-vein (p. 80, 1). . . . . **Pedicia.**

7. Rostrum much longer than the head. . . . **Ornithodes.**
   Rostrum shorter than the head (4). . . . **Amalopis**

CYLINDROTOMINI.

1. Five posterior cells; colors yellow and black. **Cylindrotoma.**
   Four posterior cells. 2

2. Antennal joints subcylindrical, elongated. 3
   Antennal joints subglobular; head and thorax conspicuously punctulate . . . . . **Triogma.**

3. Colors yellow and black. . . . . **Liogma.**
   Colors brownish and grayish. . . . . **Phalacrocera.**

PTYCHOPTERINÆ.

1. First submarginal cell much shorter than the second. **Idioplasta.**
   First submarginal cell much longer than the second. . . 2

2. Three posterior cells (**12**). . . . . **Bittacomorpha.**
   Four posterior cells. . . . . **Ptychoptera.**

TIPULINÆ.

1. Legs long and slender, especially the tarsi; anterior branch of the second vein absent, obsolete or perpendicular, the rhomboid cell more or less square. 2
   Legs not unusually slender, anterior branch of second vein present and oblique. 5

2. Antennæ thirteen-jointed; male forceps complex. **Dolichopeza.**
   Antennæ with less than thirteen joints; male forceps small, simple. 3

3. Fifth posterior cell not in contact with discal cell. **Megistocera.**
   Fifth posterior cell in contact with discal cell. . . . 4

4. Head on a neck-like prolongation of the thorax; seventh vein short, running into the anal angle. . . . **Brachypremna.**
   Head more closely applied to the thorax; seventh vein terminates in the margin at some distance from the anal angle. **Tanyprema**

5. Antennæ of ♂ pectinate or sub-pectinate. 6
   Antennæ not pectinate. 7

6. Ovipositor of ♀ long, sword-like. . . . . **Xiphura.**
   Ovipositor of ♀ long but not sword-like (p. 80, **4**). **Ctenophora.**

7. Three posterior veins arising from the discal cell, the two anterior sometimes arising together but the petiole always short (p. 80, **7**) **Pachyrrhina.**
   Two posterior veins arise from the discal cell, the anterior one furcate, petiole always of considerable length. . . . 8

8. Antennæ serrate; northern species. . . . **Stygeropis.**
   Antennæ not serrate below. 9

9. Marginal vein wanting, but one marginal cell; antennal joints short with minute bristles. . . . . **Holorusia.**
   Two marginal cells. 10

10. Abdomen slender, very long; antennæ composed of twelve joints. **Longuria.**
    Abdomen less elongate; antennæ with thirteen joints (**27**). **Tipula.**

II. Family PSYCHODIDÆ.

Thickly haired, minute flies, in appearance moth-like. Head small; ocelli wanting. Antennæ as long as the head and thorax together, bead-like; thickly haired; composed of from twelve to sixteen joints; the two basal joints shorter and short-cylindric. Proboscis usually short; or more or less elongated (*Phlebotomus*) and rigid; palpi incurved and hairy; composed of four joints of nearly equal length. Thorax not very convex, without transverse suture; scutellum rounded. Abdomen cylindrical, composed of from six to eight segments; male genitalia prominent. Legs short, densely hairy; claws small. Wings large, ovate or lanceolate in shape; when at rest lying roof-like over the abdomen; densely covered with hair or tomentum, which also forms a fringe around their margin; the costal vein continuous about the wing; veins strong, for the most part concealed beneath the hair; venation formed almost wholly by longitudinal veins; the anterior cross-vein is short and lies near the root of the wing and is often difficult of discernment; the second longitudinal vein arises near the origin of the first and is furcate. Fourth vein furcate; between these two furcations there are usually two longitudinal veins, the precise homologies of which are uncertain; the front one is often supposed to be an additional furcation of the second; or it may be a furcation of the third occurring before the anterior cross-vein, a peculiar structure found elsewhere in diptera only among the Tipulidæ (*Ptychopterinæ*). The vein just before the posterior furcation terminates near the tip of the wing. Fifth and sixth veins terminate in the border of the wing, as does also the seventh, which is, sometimes, very short.

The members of this family are often very minute, rarely exceeding the length of four millimeters; they are observed in shady places, on windows, in outhouses, or running about on leaves near streams of water, and will be readily recognized by their peculiar moth-like appearance; they run about nimbly, but their flight is weak. The larvæ live in rotting vegetable material, in dung, or in water; they are peculiar in having both open spiracles and tracheal gills; the maxillæ are imperfectly developed, there are eye-spots on the head, and the segments behind the head are without feet, but are provided with sucking disks, in the aquatic forms at least.

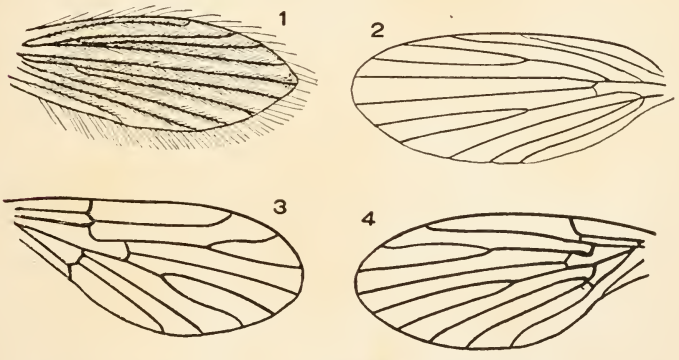


Fig. 26. Psychodidæ. 1, *Psychoda*, wing; 2, *Pericoma*, wing (Eaton); 3, *Sycorax*, wing (Eaton); 4, *Trichomyia*, wing (Eaton).

TABLE OF GENERA.

1. Two simple longitudinal veins between the forked veins. . 2
   One simple longitudinal vein between the forked veins. . 4
2. The first simple vein arises from the forked vein much beyond the anterior cross-vein (*Flebotomus!*) . . **Phlebotomus.**
   The first simple vein arises near anterior cross-vein. . . 3
3. The second simple vein ends at or near tip of wing (1). **Psychoda**
   The second simple vein ends distinctly beyond tip of wing (2). **Pericoma.**
4. The seventh longitudinal vein (the most posterior one) not much shorter than the sixth (4). . . . . **Trichomyia.**
   The seventh longitudinal vein very short (3). . **Sycorax.**

III. Family DIXIDÆ.

Fig. 27. *Dixa* species; enlarged. After Kellogg.

Rather small, slender, nearly bare species. Proboscis somewhat projecting; palpi four-jointed; antennæ long, the basal joints thick, those of the flagellum hair-like, and the joints indistinctly distinguishable. Eyes round, dichoptic; no ocelli. Thorax strongly convex, without transverse suture; scutellum transverse; metanotum arched. Abdomen long and slender, composed of seven or eight segments, thickened posteriorly in the male, pointed in the female. Legs long and slender; coxæ somewhat elongated; tibiæ without terminal spurs. Wings comparatively large; auxiliary vein present, terminating in the costa before the middle of the wing; the second vein arises from the first near the middle of the wing and appears to be the beginning of the third vein, which continues its direction while the second arches suddenly forward at or near the anterior cross-vein and is furcate; fourth vein furcate; four posterior cells pres-

ent; the two basal cells complete; the anterior cross-vein is near the beginning of the third vein, where the second vein curves forward.

The family Dixidæ comprises about a score of known species belonging to the single genus *Dixa*. The genus has been placed among the Tipulidæ and Culicidæ, but is provisionally isolated into a separate family. The larvæ are aquatic, living in ponds or slowly running water; they resemble those of the mosquitoes. The flies are found in bushy, moist places about forests, and have been observed by Winnertz dancing in the air in swarms.

IV. Family CULICIDÆ.

Slender flies, for the most part characterized by the projecting, slender proboscis and the thickly plumose antennæ of the males. Head small, subspherical; eyes reniform; ocelli wanting. Antennæ slender, elongate, composed of fourteen or fifteen joints; first joint globose, the following elongated, nearly or quite cylindrical and beset with whorls of hair, forming, with but few exceptions, in the male a dense plumosity, but shorter and less conspicuous in the female; in the male the last two joints almost always more elongated and nearly bare. Thorax ovate, arched, but not projecting over the head, without transverse suture; scutellum narrow, uni- or trilobate; metanotum usually arched. Abdomen long and narrow, somewhat flattened, composed of eight or nine segments; male genitalia prominent; ovipositor short. Legs long and slender; coxæ not elongate; tarsi long; claws often denticulate, especially in the males.

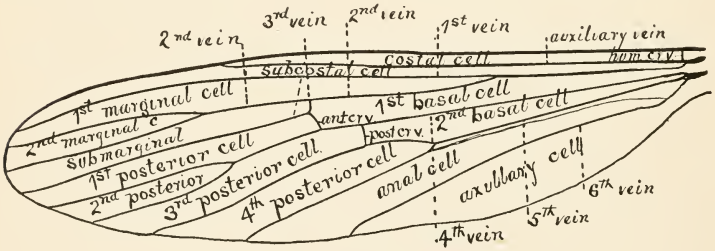


Fig. 28. Venation of *Culex*.

Wings long and narrow, while at rest lying flat over the abdomen; with six fully developed longitudinal veins reaching the costal margin; the hind margin is

fringed with hair or scales and the costal vein encompasses the wing; auxiliary vein distinct, reaching to or beyond the middle of the wing; second, fourth and fifth longitudinal veins furcate; third vein simple, arising from the second angularly beyond the middle of the wing; anterior cross-vein situated near or even proximal of the origin of the third vein. Two basal cells present, elongate, the anal cell wide open. Veins of the wings clothed with scales.

The foregoing description and figure of the wing do not wholly agree with those of other writers. It is evident, unless we change the nomenclature of the brachycerous flies, that the furcation of the second vein does not form a submarginal cell; the so-called 'first submarginal cell' is in reality the second marginal. Furthermore, it is as clearly apparent that the so-called 'posterior cross-vein' is not the vein of that name among the brachycerous and cyclorrhaphous flies, but is, rather, the 'discal' or 'discoidal cross-vein', or the 'anterior basal cross-vein'; or, at least, a cross-vein which has not yet received a definite name.

Since the last edition of this work was published, in 1896, the marvelous discoveries in the life histories of the Culicidæ, and their agency in the transfer of disease, have given to the family an importance in man's economy second to that of no other group of insects. Indeed, one may say with entire truth that these little flies, or 'gnats' as the English call them, are the most baneful and pestilential of all known insects. The microscopical parasites producing malaria, yellow fever and filariasis are now known with certainty to be transferred by the agency of certain mosquitoes from one human being to another, and it is probable, though of course not certain, that if all the germ-bearing mosquitoes could be made extinct these diseases would at least cease to trouble

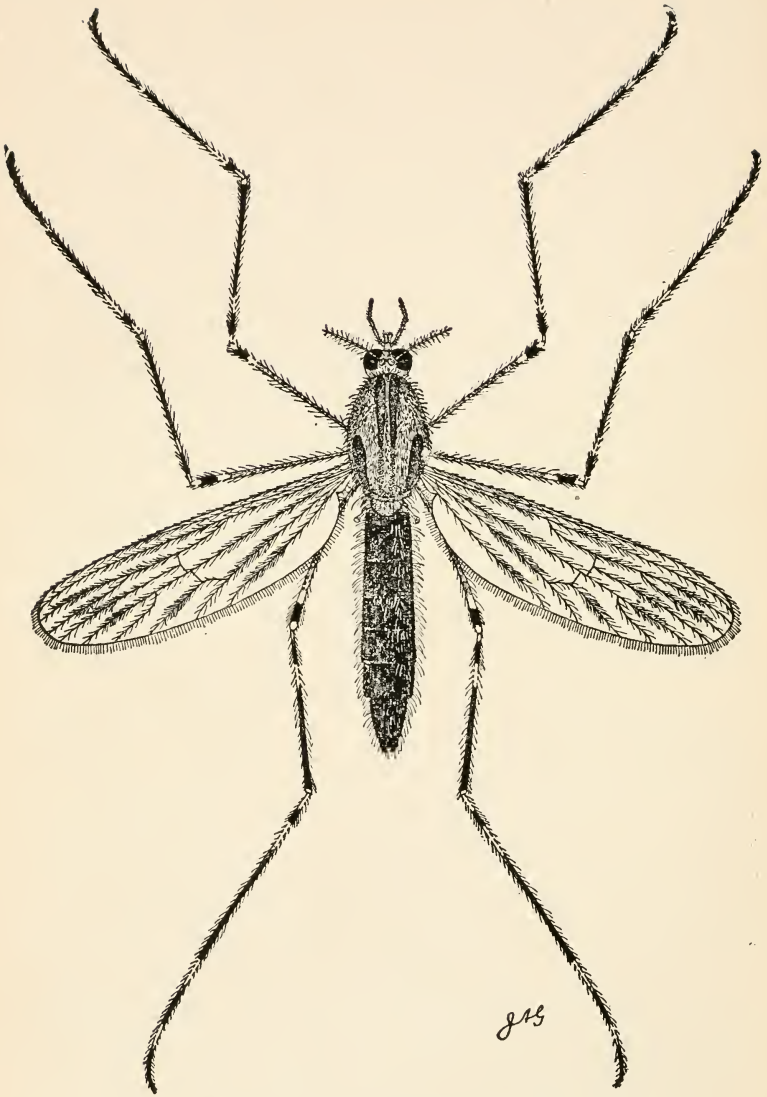


Fig. 29. *Mochlonyx cinctipes.* Female adult; enlarged. After J. B. Smith.

mankind. The parasitic microorganism is a small protozoan which undergoes development in the red corpuscles of the blood, destroying them, and there seems to be no way, in general at least, in which it may be transferred from one person to another save by the activity of these insects. Taken into the mosquito's stomach with the blood sucked up by the insect it there undergoes sexual regeneration, of which the newly generated germs or 'blasts', penetrating the walls of the mosquito's stomach, reach the salivary glands, and are thence transferred with the poisonous saliva emitted by the insect into the wounds made by its puncturing 'bites'.

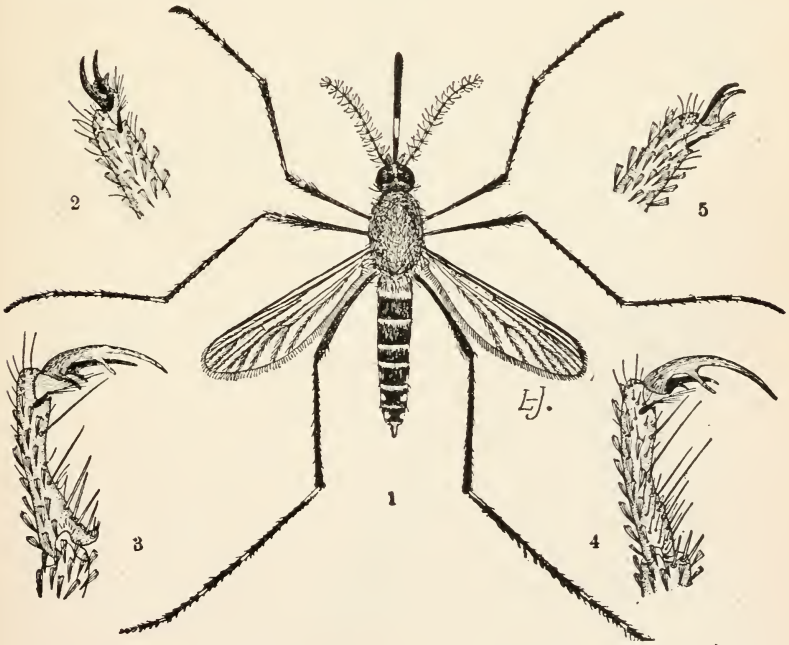


Fig. 30. *Culex taeniorhynchus*. 1, female adult; 2, front claws of female; 3, front, 4 middle, 5, hind claws of male; all much enlarged. After J. B. Smith.

Not all mosquitoes are criminals in this respect. Only certain forms of *Anopheles* (in its wide sense) are known to carry the germs of malaria; while but a single species,

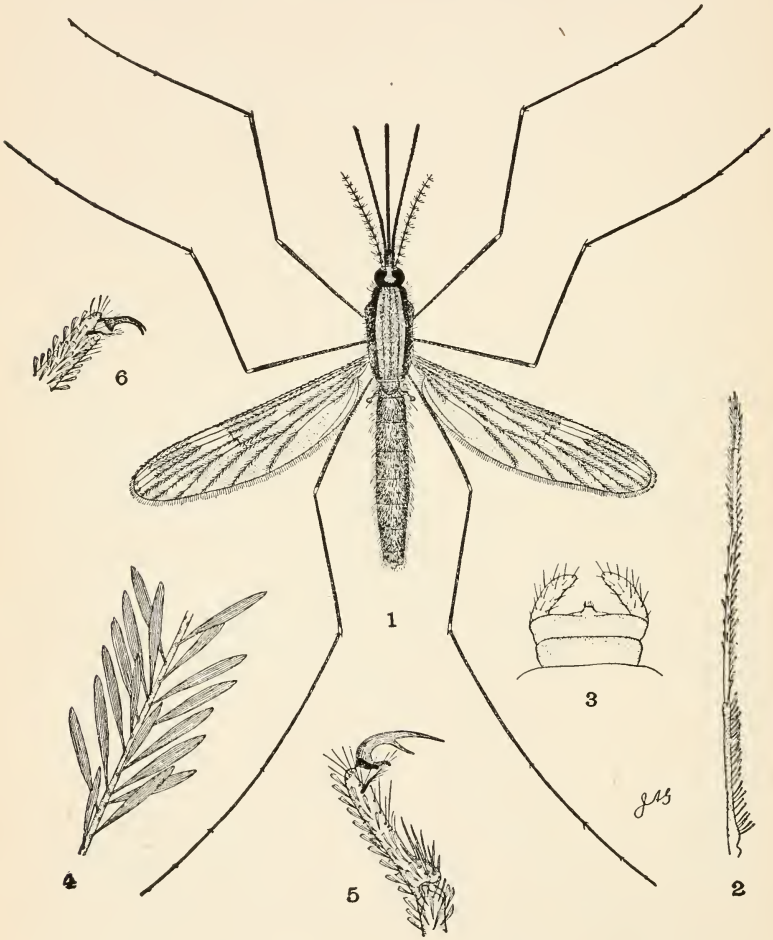


Fig. 31. *Anopheles punctipennis.* 1, female adult; 2, female palpus; 3, genitalia; 4, part of wing vein showing scales; 5, front, 6, middle claws of male; all much enlarged. After J. B. Smith.

the *Culex* or *Stegomyia fasciata*, is so far known to cause the deadly yellow fever. But these disease-bearing species are widely distributed over the earth, accounting for the wide distribution of malaria and yellow fever.

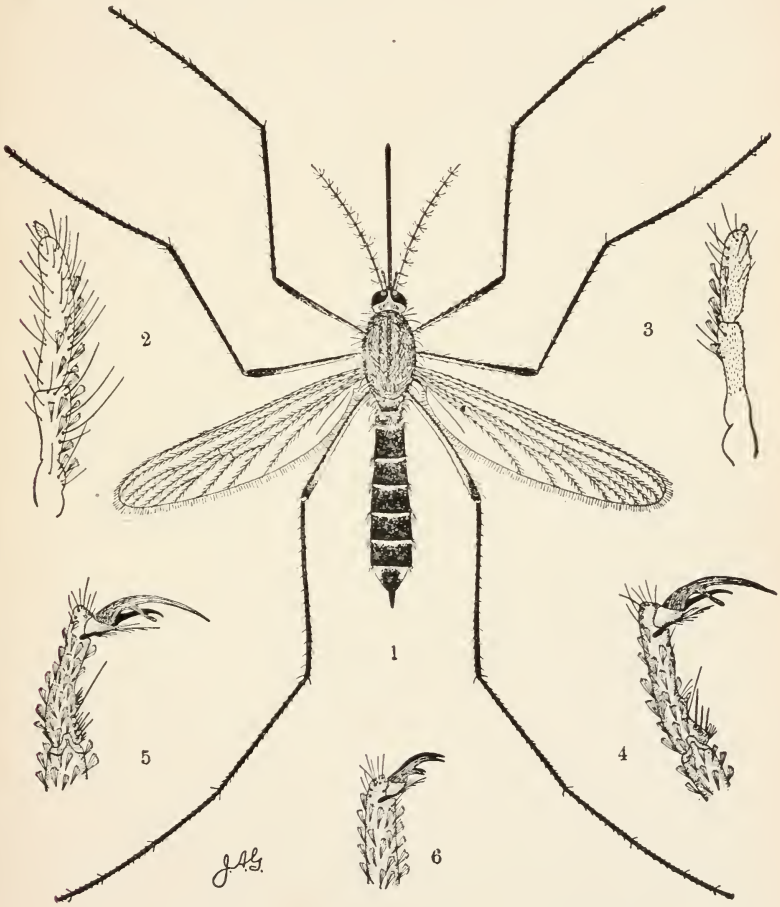


Fig. 32. *Aedes fuscus*. 1, female adult; 2, female palpus; 3, male palpus; 4, front, 5, middle, 6, hind claws of male; all much enlarged. After J. B. Smith.

Probably we shall yet learn of other mosquitoes which are culprits in these respects.

This gravely important bearing of the mosquitoes in man's economy has given a tremendous impulse to their study, though not always with the most happy results so far as their taxonomy is concerned. Whereas ten or twelve years ago only about one hundred and fifty species of the family were known, we now have an accredited list of Culicidæ of nearly or quite six hundred species, and there are probably several hundred more yet awaiting discovery.

It seems a fact that the mosquitoes present but few and slight structural differences among themselves; the many closely related forms seem to indicate a late geological crudescence. Such organisms are always difficult to classify. The wing venation has acquired much fixity, whereas the many secondary sexual differences in the mouth-organs would indicate a late adaptation to blood-sucking habits. The Culicinæ probably have developed from the corethrine type, which is doubtless an older type, now decidedly on the wane. Until within a few years scarcely a half dozen genera of the mosquitoes had been recognized by dipterologists, and they were based chiefly on the secondary sexual mouth characters. Within these few years, however, the numerous writers on this group of insects have proposed fully one hundred genera, for the most part merely subdivisions of the older genera, founded on minor characters, chiefly the shape and arrangement of the scales of the body and wings. It seems to be the consensus of opinion among other dipterologists that the use of such characters has been carried to an undue and even absurd extreme. Of course the first requisite in classification is that distinguishing characters shall be 'natural', that is genetic, not homoplastic or parallel characters. When such are found it

really makes little difference how far they are carried, save that their use in one group, necessitates or stimulates the use of like minor characters in other groups. One cannot raise a genus of Culicidæ to family rank, without raising all other genera of like degree *pari passu*.

But I am firmly of the opinion that the scale characters are in a high degree artificial, and that their use will

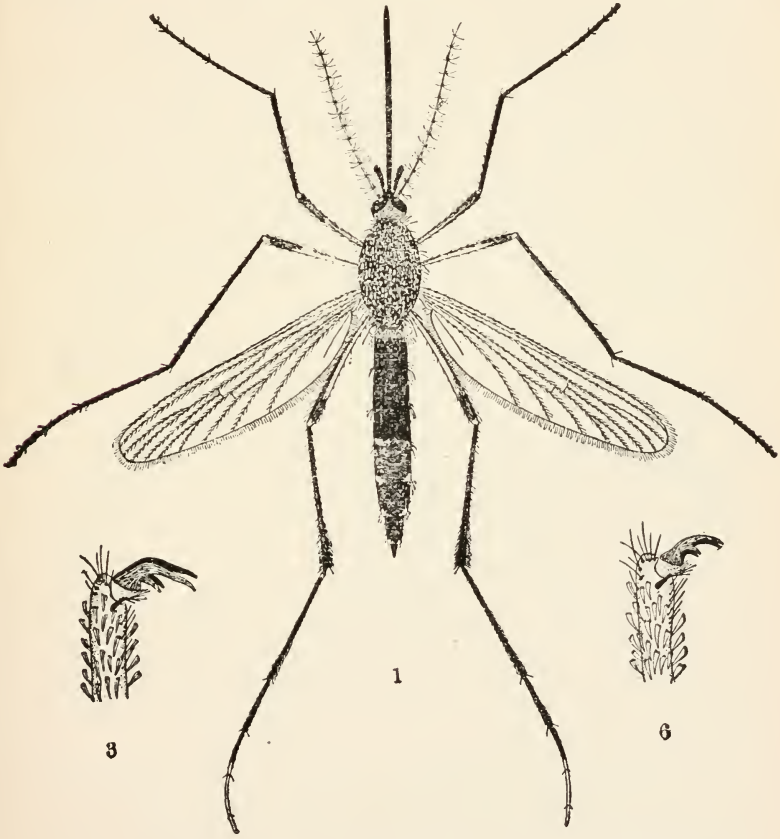


Fig. 33. *Aedes musicus*. 1, female adult; 3, claws of female front; 6, hind claws of male; enlarged. After J. B. Smith.

never be accepted by dipterologists in general. And secondary sexual characters should also be tabooed so far as possible, since they represent merely evolutional instability.

The formation of so many genera from these slight characters, is, however, no worse than the attempt to classify and name genera and species purely from the larval stage, which has been done to a degree never before attempted by scientific dipterologists.

Upon the whole the characters made use of in the following table, verbally modified from Dyar and Knab, come nearest to my own views of proper classificatory characters for the family. I am not able to test the table thoroughly, and cannot vouch for it, but I believe it to be the best that has so far appeared. The student may also consult a recent table of the genera published by D. W. Coquillett.*

The habits of the immature stages of the Culicidæ are so familiar to all that little need be said here regarding them.

The eggs are laid by the females upon the surface of stagnant or nearly stagnant water, in groups or singly, whence the young larvæ, hatching, descend into the water to form those active little creatures of the rain-barrel, commonly known as 'wigglers'. The pupal stage is less active, passed in large part near the surface of the water, hanging by the respiratory tubes. The adult insect emerges from the pupal skin through a rent, using its discarded shell as a temporary raft until its wings are fully extricated.

The following description of the larvæ of the mosquitoes is paraphrased from Dyar and Knab:

* Bull. U. S. Dept. Agric. Tech. Ser. No. 11 (1906).

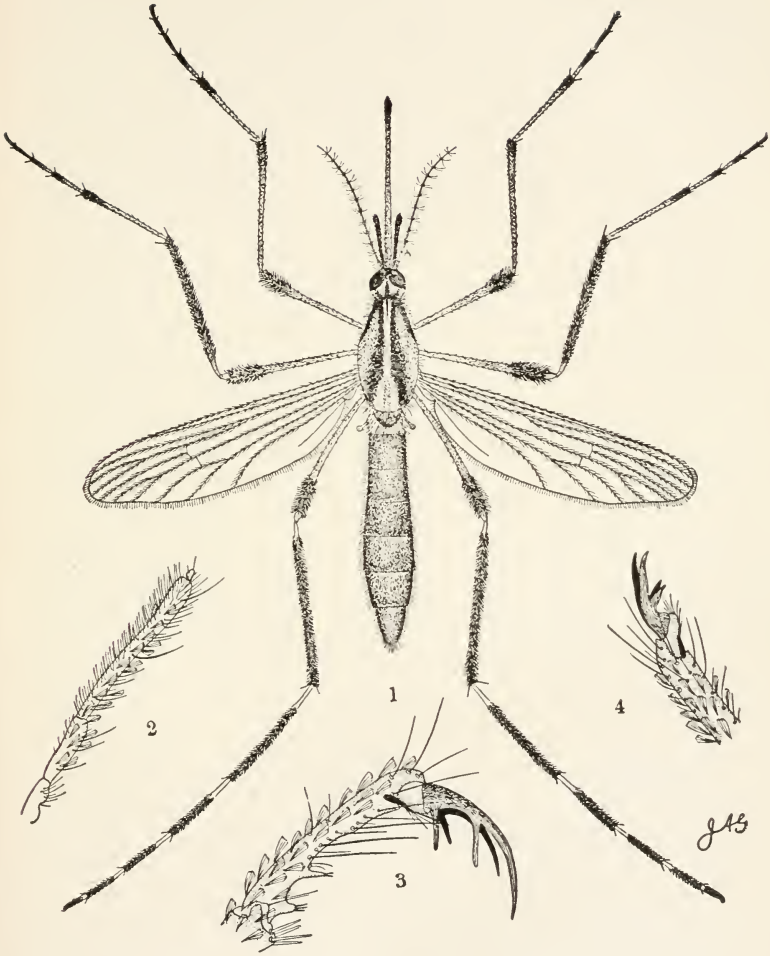


Fig. 34. *Psorophora ciliata.* 1, female adult; 2, female palpus; 3, front; 4, hind claws of male; enlarged. After J. B. Smith.

Head well formed, enclosed in a chitinous covering; with compound eyes, single-jointed antennæ, a group of hairs before the oral orifice, toothed mandibles, maxillæ, and single-jointed palpi. Thoracic segments consolidated into a transversely elliptical flattened mass; abdomen with nine slender and moniliform segments, the eighth with a dorsal, respiratory opening, often prolonged into a chitinous tube; last segment furnished with a chitinous plate, and usually with four delicate anal appendages. The body has setæ in tufts or singly, usually more or less conspicuously feathered. From other aquatic nematocerous larvæ, the mosquitoes are distinguished by the presence of the mouth-brush, the shape of the anal segment and the absence of abdominal feet. The larvæ of *Dixa* and the Corethrinæ are practicably indistinguishable from those of the Culicinæ, save by minor characters.*

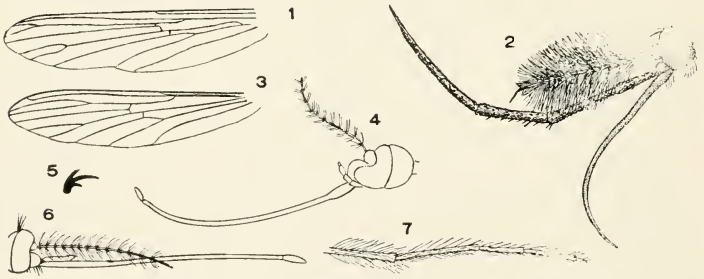


Fig. 35. Culicidæ. 1, *Megarhinus*, wing; 2, *Megarhinus*, head, male; 3, *Aedes*, wing; 4, *Hæmagogus*, head, female; 5, front claws of *Hæmagogus*, male; 6, *Wyeomyia*, head of female; 7, *Corethra*, hind tarsus.

TABLE OF GENERA.

Proboscis short, not adapted for piercing. . . **Corethrinæ.**

Proboscis much longer than the head, firm, adapted for piercing. Mosquitoes. . . . . **Culicinæ.**

*I especially commend to the student interested in this family of flies the comprehensive and richly illustrated Report upon the Mosquitoes of New Jersey (1904), by Prof. J. B. Smith.

CORETHRINÆ.

1. Hind metatarsi shorter than the following joint (*Corethra** Coquillett). (fig. 29) . . . . . **Mochlonyx.**
   Hind metatarsi longer than the following joint. . . . 2

2. Small species; ungues simple. 3
   Large species (10 mm); ungues bifid. . . . **Pelorempis.**

2. Antennæ verticillate (*Sayomyia* Coquillett) (**7**). **Corethra.**
   Antennæ of male thickly clothed with long hairs; of the female with a basal and an irregular median circlet of hairs on each joint. . . . . **Corethrella.**

CULICINÆ.

AFTER DYAR AND KNAB.

1. Metanotum without setæ (Culicini). 2
   Metanotum with setæ (Sabethini). 15

2. Scutellum evenly rounded, not lobed. 3
   Scutellum distinctly trilobate. 4

3. Second marginal cell longer than its petiole (fig. 31) **Anopheles.**
   Second marginal cell less than half as long as its petiole (**1, 2**). **Megarhinus.**

4. Hind tibiæ near their tip with a row of seven to twelve closely set setæ. 5
   Hind tibiæ with none to five sparsely set setæ. . . . 14

5. Scutellum with its median lobe elongate, collar-like, not tuberculary prominent, ... 6
   Scutellum with its median lobe distinctly prominent and tubercular. 7

6. Terminal antennal joints slender, long. . . **Mansonia.**
   Terminal antennal joints short, broad. . . . **Aedomyia.**

7. Second joint of antennæ very long, 14:1. . **Deinocerites.**
   Second joint of antennæ moderately long, less than 8:1. . 8

8. Second marginal cell less than half as long as its petiole. **Uranotænia.**
   Second marginal cell at least nearly as long as its petiole. 9

* My examination of the literature leads me to quite different conclusions than those of Coquillett regarding the types of *Corethra* and *Mochlonyx*. There is no call for disturbing these names so long established.

9. Head with a distinct neck, the occiput broad and exposed (fig. 34). **Psorophora.**
   Head without distinct neck, appressed to the thorax. . 10
10. Cross-veins approximated and nearly in line with the basal section of the third vein. . . . . **Culiseta.**
    Cross-veins not approximated, separated by at least the length of the posterior. 11
11. Last segment of the female abdomen not extensile, large, truncate; male genitalia with the harpes slender, columnar, with bent, spined tip. . . . . **Tæniorhynchus.**
    Last segment of the female abdomen extensile, slender; male genitalia with harpes broad, concavely curved. . . 12
12. Clypeus bare. 13
    Clypeus with dense appressed scales. . . . **Stegomyia.**
13. Prothoracic lobes approximated (**4, 5**). . **Hæmagogus.**
    Prothoracic lobes well separated (figs. 32, 33). . **Aedes.**
14. Empodia large. . . . . **Lutzia.**
    Empodia small (fig. 30). . . . . **Culex.**
15. Clypeus without hairs. 16
    Clypeus hairy on the sides. . . . . **Joblotia.**
16. Prothoracic lobes contiguous, densely hairy. . **Sabethes.**
    Prothoracic lobes well separated. 17
17. Eyes narrowly separated by the front; proboscis rather short, swollen at tip. 18
    Eyes contiguous at vertex. 19
18. Hind tarsi with two claws, normal (**6**). . . **Wyeomyia.**
    Hind tarsi with but a single claw. . . . **Limatus.**
19. No erect forked scales on occiput; proboscis longer than the body. **Phoniomyia.**
    With a row of erect forked scales on occiput; proboscis not longer than the body. 20
20. Face normal, smooth. . . . . **Lesticocampa.**
    Face with a conical process above the clypeus. **Runchomyia.**

The following synonymy is given by Dyar and Knab:

Anopheles Meigen: *Myzomyia* Blanch., *Cycloleppteron* Theob: *Nototricha* Coq., *Cellia* Theob., *Arribalzagia* Theob., *Coelodiazesis* D. and K.

Mansonia Blanch.: *Pneumaculex* Dyar.

Tæniorhynchus Lynch: *Coquillettidia* Dyar.

Aedes Meigen: *Ochlerotatus* Lynch, *Hetoronycha* Lynch, *Janthinosoma* Lynch, *Conchyliastes* Coq., *Grabhamia* Theob., *Howardina* Theob., *Culiselsa* Felt, *Culicada* Felt, *Ecculex* Felt, *Protoculex* Felt, *Pseudoculex* Dyar, *Gymnometopa* Coq., *Lepidoplatys* Coq., *Feltidia* Dyar, *Ceratocystia* D. & K.

Hæmagogus Will.: *Cacomyia* Coq., *Stegoconops* Lutz.

Culex Linn.: *Neoculex* Dyar, *Culicella* Felt, *Melanoconion*, Theob., *Tinolestes* Coq., *Micrædes* Coq., *Isostomyia* Coq., *Mochlostyrax* D.&K.

Sabethes R.-D.: *Sabethoides* Theob.

Wyeomyia Theob.: *Dendromyia* Theob.

Limatus Theob.: *Simondella* Laveran.

Joblotia Blanchard: *Trichoprosopon* Theob.

V. Family CHIRONOMIDÆ.

Gnatlike flies of slender form, seldom reaching ten millimeters in length; the males conspicuous for their plumose antennæ. Head small, spheroidal, more or less concealed by a projecting, hoodlike thorax. Antennæ threadlike or beadlike with not less than six nor more than fifteen joints; in the male usually with a long dense plumosity; in the female with inconspicuous hairs and sometimes with a smaller number of joints; the first joint short and thick. Eyes reniform or oval; ocelli wanting or rudimentary; proboscis short; palpi three or four-jointed; the last usually elongated. Thorax ovate, very convex, usually projecting above in front more or less over the head; without transverse suture; scutellum small, hemispherical. Abdomen usually narrow and long, composed of eight segments; hypopygium projecting forcep-like; ovipositor very short, but little developed; legs usually slender and long; especially the front pair; coxæ of moderate length. Tarsi often much elongated. Wings narrow and long; bare or uniformly hairy; anterior veins stronger and darker colored than the others; auxiliary vein complete, but usually very weak and slender; second longitudinal vein usually wanting; third vein sometimes forked close to its origin, the upper branch often rectangular and having the appearance of a supernumerary cross-vein; fourth vein often, the fifth usually, furcate; posterior cross-vein often wanting; the costal vein terminates near the tip of the wing at the termination of the third vein.

This family comprises a large number of very delicate, often minute flies, commonly known as midges, which

have not been much studied by entomologists; about one thousand species are known throughout the world. They will be distinguished from the mosquitoes, which they resemble very much, by the costal vein not being continuous on the posterior side of the wing. The antennæ are usually conspicuous, especially in the males, although agreeing in this respect with male mosquitoes. The larvæ are soft-skinned, worm-like, often blood-red in color and usually aquatic, as are also the active pupæ, though some live in decomposing vegetable matter, or in the earth. These midges are often seen, especially in the early spring or in the autumn, in immense swarms, dancing in the air, and have doubtless in many cases given rise to exaggerated stories of mosquitoes. Over meadows in the Rocky Mountains the writer has seen them rise at nightfall in the most incredible numbers, producing noise like that of a distant waterfall, and audible for a considerable distance. While at rest they usually raise their forelegs in the air and keep them constantly vibrating. Aquatic larvæ may be frequently met with in standing water, often extremely delicate little creatures, so transparent as to be hardly distinguishable; they have been dredged from nearly one thousand feet below the surface of Lake Superior.

Most of the species are inoffensive, or actually beneficial as scavengers. There are some, however, belonging to the genus *Ceratopogon* and its allies, and known generally as midges, or punkies, which have the power of sucking blood and are extremely annoying. In the White Mountains, at the seashore, along mountain streams generally, and in the West Indies they are especially troublesome. The larvæ live in the flowing sap of trees, in decaying vegetation, under fallen leaves, or in water.

I have included in this family, and have added to Professor Johannsen's table the diagnosis of the genus

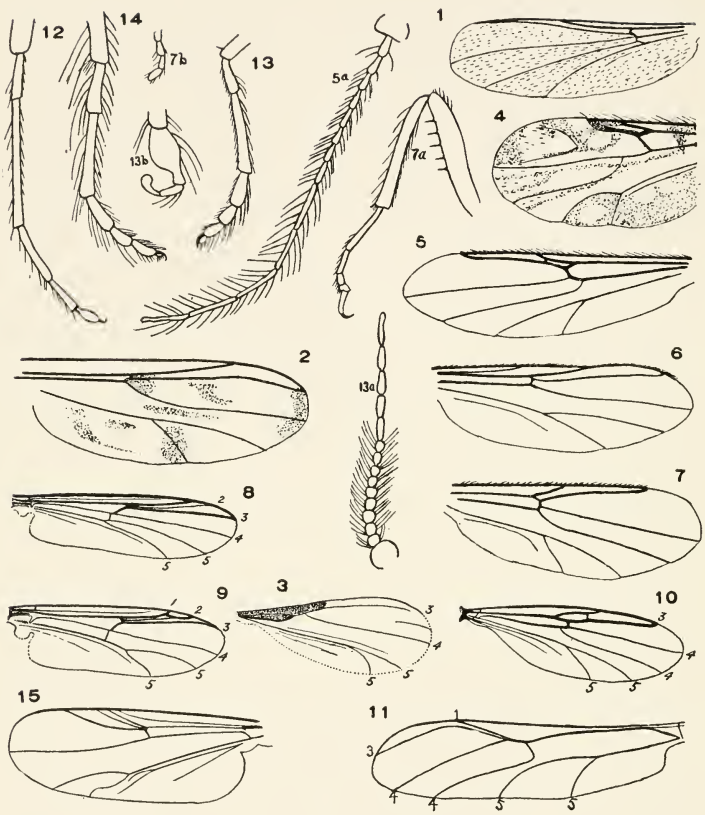


Fig. 36. Chironomidæ. 1, *Ablabesmyia*, wing; 2, *Chironomus*, wing; 3 *Corynoneura*, wing (Johannsen); 4, *Culicoides*, wing; 5, *Johannseniella*, wing; 5a, *Johannseniella*, antenna; 6, *Orthocladius*, wing; 7, *Bezzia*, wing; 7a *Bezzia*, front leg; 7b, *Bezzia*, palpus; 8, *Diamesa*, wing (Johannsen); 9, *Procladius*, *Tanypus*, wings (Johannsen); 10, *Johannseniella*, *Palpomyia* wings (Johannsen); 11, *Stenoxenus*, wing (Coquillett); 12, 13, 14, *Ceratopogon* (empodium of 12, omitted); 13a, *Ceratopogon*, antenna; 13b, *Ceratopogon* palpus; 15, *Camptocladius* (Wulp).

Stenoxenus Coquillett, (fig. 11) referred by its author to a new family. Mr. Coquillett's interpretation of the neuration is clearly wrong: the fourth vein is coalescent with the third and first for a considerable distance, but all three veins are distinct distally and of the usual Chironomid structure. The genus was based upon a single female specimen without antennæ, so that its more exact position in the family must await further study.

TABLE OF GENERA.

BY PROF. O. A. JOHANNSEN.

1. First, third and fourth longitudinal veins coalescent for the larger part of the distance between the humeral cross-vein and the posterior branch of the fourth; third vein long, not connected with the first vein by a cross-vein; front concave (11). **Stenoxenus.**
   Fourth vein not at all coalescent with the first. . . . 2
2. Wings short, strap-like, thickened, and without distinct venation. **Eretmoptera.**
   Wings normal. 3
3. Posterior (i. e. the 'anterior basal') cross-vein present, the second basal cell complete. 4
   Posterior cross-vein absent, no second basal cell. . . . 14
4. Antennæ with fifteen joints in both sexes, rarely twelve or fourteen jointed in the female; long plumose in the male, penultimate joint elongate, apical joint very small. (*Tanypus*, sens. lat.) 5
   Antennæ of the male with nine or with fourteen joints, the female with seven or eight joints. 12
5. Wings bare, ... 6
   Wings hairy. 9
6. Fork of the fifth vein petiolate. 7
   Furcation of the fifth vein slightly proximad of the posterior cross-vein. 8
7. First vein forked at its extremity (9). . **Procladius** Skuse.
   First vein simple. . . . . **Psilotanypus** Kieffer.
8. First vein forked at its extremity. . **Anatopynia** Johannsen.
   First vein simple. . . . . **Protanypus** Keiffer.

9. Fork of the fifth vein petiolate. 10
Furcation of the fifth vein slightly proximad of the posterior cross-vein. 11

10. First vein forked at its extremity (9). . . . **Tanypus.**
First vein simple. . . . . **Trichotanypus** Kieffer.

11. First vein forked at its extremity. **Ablabesmyia** Johannsen.
Fork of the first vein and the second vein pale and indistinct; antennæ of the female twelve jointed. . **Isoplastus** Skuse.

12. Fourth tarsal joint shorter than the fifth, obcordate. . . 13
Fourth tarsal joint linear. . . . **Prodiamesa** Kieffer.

13. Antennæ of the male with fourteen plumose joints; terminal joint very long; antennæ of the female with seven or eight short haired joints (8). . . . . **Diamesa.**
Antennæ of both sexes short-haired, the terminal joint oval; those of the male with nine, of the female with eight joints.
(The female does not seem to differ from *Diamesa*.)
Eutanypus.

14. Thorax with a median longitudinal fissure; small species, usually with blackish wings having white markings. **Chasmatonotus**
Thorax without longitudinal fissure. 15

15. Claws cleft; first vein ending not far from the tip of wing; antennæ seven jointed in both sexes. . . **Telmatogeton.**
Claws not cleft, though sometimes toothed on the side. . 16

16. First vein thickened at apex, anal angle of wing obsolete; antennæ of the male with ten or eleven joints, of the female with six joints; very minute flies (3). . . . **Corynoneura.**
Not with all the above characters. 17

17. Fourth longitudinal vein simple; antennæ of male with fourteen joints, closely sessile, plumose, the terminal joint cylindrical; antennæ of the female with seven joints, short haired; (second and third joints sometimes more or less coalescent). *Chironomus*, sens. lat. 18
Fourth longitudinal vein furcate; antennæ of both sexes fourteen jointed, except with *Tersesthes*. 25

18. Fourth tarsal joint obcordate, shorter than the fifth; front metatarsus shorter than its tibia; wing under low magnification bare. **Thalassomyia.**
Fourth tarsal joint linear. 19

19. Wings bare. 20
Wings hairy. 23

20. Front metatarsi as long or longer than tibiæ (2). **Chironomus.**
Front metatarsi distinctly shorter than their tibiæ. . . 21

21. Legs, especially the front pair, sharply black and white annulate. **Cricotopus.**
Legs not so banded. 22

22. Posterior branch of fifth vein sinuous (15). **Camptocladius.**
Posterior branch of the fifth vein straight or gently arched (6). **Orthocladius.**

SUBGENERA OF ORTHOCLADIUS.

a. Eyes hairy. . . . . **Trichocladius** Kieffer.
Eyes bare. . . . . b.

b. Pulvilli large, empodium long and filiform. **Psectrocladius** Kieffer.
Pulvilli wanting. . . . . c.

c. Empodium filiform. . . . **Dactylocladius** Kieffer.
Empodium not distinct. . . . . **Orthocladius.**

23. Front metatarsi longer than their tibiæ; anal angle of wings but slightly developed; anterior cross-vein very short and sometimes difficult to distinguish. . . . . **Tanytarsus.**
Front metatarsi shorter than their tibiæ. 24

24. Thorax produced conically, nipple-like, in front over the head; hind tibiæ dilated and hairy. . . . **Eurycnemus.**
Thorax moderately produced, hind tibiæ not dilated. **Metriocnemus.**

25. Antennæ with thirteen joints (counting the large basal) wings with anal angle; palpi three-jointed, penultimate joint swollen. **Tersesthes.**
Antennæ with fourteen joints in both sexes, the terminal joint only moderately elongated; male antennæ plumose (*Ceratopogon*, sens. lat.) 26

26. Last tarsal joint with empodium, either distinct or developed pulvilliform; wings usually hairy; femora without spines, tarsal claws equal. 27
Last tarsal joint without empodium; wings usually bare. . 28

27. Empodium well developed, almost as long as the claws, these without setæ (12, 13, 14). . . . . **Ceratopogon.**

SUBGENERA OF CERATOPOGON.

a. Wings bare. . . . . **Atrichopogon** Kieffer.
Wings hairy. . . . . b.

b. Hind metatarsus longer than the following joint, sometimes in the male only equal. . . . . **Ceratopogon.**

c. Hind metatarsus shorter than the following joint, sometimes equal in the female. . . . **Forcipomyia** Megerle.

Empodium not so distinct, less than half as long as the claws, the latter with setæ at base; hind metatarsus always longer than the following joint. (*Oecacta* is probably a synonym) (4). **Culicoides** Latreille.

28. A cross-vein between the first and third veins. . . . 29
No cross-vein between the first and the third veins. **Bezzia** Kieffer.

SUBGENERA OF BEZZIA.

a. Femora without prominent spines on the underside. **Probezzia** Kieffer.

b. Some or all femora with spines. . . . . **Bezzia.**

29. Femora unarmed, that is without stout black spines on the under side (*Ceratolophus* Kieffer.) (5) **Johannseniella** Williston.

Some or all the femora spinose beneath. 30

30. Either fore or hind femora much thickened. . . . 31
Femora not noticeably thickened (10). **Palpomyia** Megerle.

SUBGENERA OF PALPOMYIA.

a. Antennæ of both sexes verticillate with short hairs. **Alasion** Rondani.

Antennæ of the male plumose. . . . . b.

b. Last tarsal joint with two rows of coarse spines below. **Sphæromyas** Stephens.

Last tarsal joint hairy below. . . **Palpomyia** Megerle.

31. Fore femora thickened. . . . . **Heteromyia.**
Hind femora thickened. . . . . **Serromyia** Megerle.

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Williston. Journal N. Y. Ent. Soc. XV. March, 1907.

VI. Family CECIDOMYIDÆ.

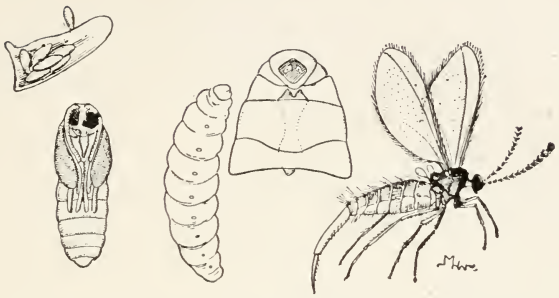


Fig. 37. *Diplosis pini-radiatæ*, enlarged. After Kellogg. Eggs, pupa, larva, 'breast-bone' and imago.

Small, slender flies with broad wings, and long antennæ and feet. Head small; eyes round or reniform, sometimes holoptic; ocelli usually wanting; antennæ long, cylindrical or bead-like, composed of a large number of joints—ten to thirty-six; in many species the joints beaded or petiolate and verticillate, especially in the ♂; proboscis short, very rarely elongated; palpi usually with four joints. Thorax ovate; more or less convex, without transverse suture; abdomen composed of eight segments; hypopygium composed of a pair of projecting hooklets; ovipositor sometimes much elongated. Legs long and slender; coxæ not very long; tibiæ without terminal spurs; the first joint of tarsi sometimes very short. Wings large, usually hairy, narrowed at the root, without alula; at the most with five, usually with but three longitudinal veins; viz, the first, the third, and the fifth; the fourth and the sixth sometimes present; the humeral cross-vein indistinct, or wanting; costal vein enclosing the entire wing; veins all weak; the fifth usu-

ally furcate; anterior cross-vein very near the root of the wing, often appearing as the beginning of the third vein, the real origin of the third vein having the appearance of a short cross-vein; only one basal cell present.

The family Cecidomyidæ includes a very large number of frail, delicate, often very minute flies, but is of the greatest interest to the biologist as well as the economic entomologist. At present about 600 species are known from Europe alone.

The egg of the Cecidomyidæ is somewhat elongated, rounded at both ends, orange-yellow or white in color. The time required for hatching is very variable and depends upon the weather, sometimes requiring a very few hours, but more generally a few days or even weeks. The larval food is almost wholly vegetable. The larvæ of some species have been bred from decaying wood and bulbs, others from under the bark of trees, or from fungi. But the great majority prefer living plants, attacking the soft and green parts. Most of the larvæ are monophagous, living almost exclusively on a single kind of plant, or at least closely allied plants; but there are certain exceptions, such as *C. sisymbrii*, which is said to form the gall in spring on the barberry, and later in the season on a nasturtium. There are certain others which are inquilinous, that is guests or parasites in galls formed by other Cecidomyids. Finally, some live parasitically in the society of plant lice. Not a few, such as the Hessian fly, live upon the surface of plants, or in the axils of their leaves; but the greater number penetrate inside the plant, producing the so-called galls. Every part of the plant from the root to the flower and the fruit is liable to such attacks. With a few rare exceptions, each species attacks the same part of the plant and deforms it in the same manner. The galls cause deformations and excrescences attached to the stalk, stems, or flowers, de-

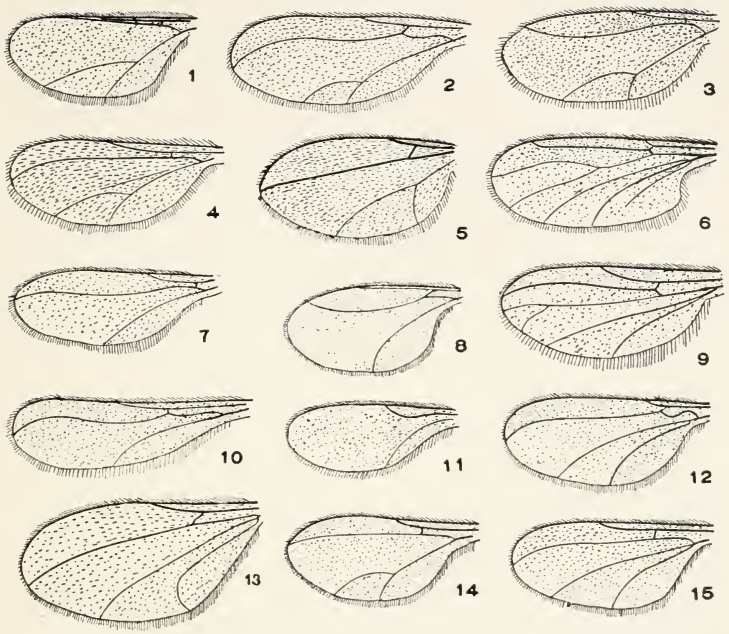


Fig. 38. Cecidomyidæ. 1, *Lasioptera;* 2, *Epidosis;* 3, *Cecidomyia;* 4, *Hormomyia;* 5, *Trichopteromyia;* 6, *Lestremia;* 7, *Miastor;* 8, *Spaniocera;* 9, *Catocha;* 10, *Colpodia;* 11, *Heteropeza;* 12, *Asynapta;* 13, *Winnertzia;* 14, *Diplosis* (*Lestodiplosis*); 15, *Winnertzia.*

stroying the plant-tissue. When first hatched the larvæ are colorless and translucent, with the alimentary canal showing through the skin greenish. Later in life they assume different shades of red or yellow. They have the extraordinary number of fourteen segments, thus forming an apparent exception to the larvæ of all other insects, which as a general rule, have thirteen. The supernumerary segment is placed between the head and first thoracic segment. The larvæ have nine pairs of stigmata along the sides of the body apparent as more or less nipple-shaped projections. The head is not differentiated;

the jaws are rudimentary and there are large two-jointed palpi or antennæ. The last abdominal segment is smooth and rounded, sometimes with tubercles or a pair of horny processes which are said to be used by the larvæ in leaping. On the under side of the body at the junction of the first thoracic with the supernumerary segment there is a horny, more or less elongated appendage whose use or homology is unknown. It varies in shape in different species, the free end sometimes terminating in two points, sometimes in one, sometimes toothed and serrated. This organ, the *spathula sternalis* of Mik, has been called by Osten Sacken the 'breast bone'; in England it is known as the 'anchor process'. (See figure of *Diplosis pini-radiatæ*). By some it is thought to be a pseudopod; by others the mentum; and Miss Ormerod believes its function is that of a scraper or digger in obtaining food from the stems. More probably its use is for locomotion, or for changing the position of the larvæ in its cocoon or case. The motions of the larvæ are usually slow, save of those which live on the surface of leaves. Those which change their abode before assuming the pupa state become very active about the period of metamorphosis. A very great activity was observed by Winnertz in some such larvæ after a thunder storm. They left their hiding places under ground and crawled about restlessly for some time; repeating these actions after every thunder storm, some even two months after leaving their galls.

Owing to their rudimentary mouth-parts it seems evident that the larvæ must feed upon juices only, and that they need very little nourishment is shown by the fact that they attain their full growth and development in a gall just large enough to enclose them, apparently hermetically sealed and for the most part with hard walls. It is probable that they absorb nourishment in a quiescent state. As many as sixty individuals have been known

to live in a single gall. What causes the galls is not easy to say; probably some peculiar irritation produced by the insect. It is probable that the larvæ generally do not undergo moulting like most dipterous larvæ. Before assuming the pupa state some larvæ leave their galls and conceal themselves under ground, in dry leaves and moss or under the bark of trees; while others, on the contrary, complete their transformation within the gall itself. The pupæ are generally, but not always, enclosed in the cocoon, which Winnertz says is produced by an exudation or excretion from the larvæ and is not spun. Larvæ which had fastened themselves to the leaf were surrounded in twenty-four hours by a white halo of thread-like particles like spicules or crystals, the larvæ remaining almost wholly motionless. The cocoon is completed within a few days but even then shows no traces of a genuine web. There seems to be no doubt, however, but that they do in some cases actually spin a cocoon, as is so frequently the case among the fungus-gnats. The change to the pupa state is marked by an alteration of color, the anterior segments of the larvæ become distended, and the legs, wings, and antennæ developing and rapidly attaining their full pupal dimensions.

The period of pupation is very variable, depending upon warmth and moisture. The development is retarded by cold, though they are capable of withstanding a very low degree of temperature.

One of the most remarkable things in the biology of these or any other insects was discovered by Wagner in 1860. According to this scientist, the larvæ of certain species belonging to the genus *Miastor*, and which live under the bark of trees, produce from ovary-like organs a number of eggs which hatch within the abdominal cavity of the parent and there remain, feeding upon the

abdominal tissues which surround them, until they are consumed. They then escape to increase in size and produce another generation in the same remarkable manner. These series of asexual reproductions are repeated until finally, from the last brood, pupæ are developed which undergo their transformation into imagines, and from which a new series of eggs, agamic broods of larvæ and pupæ in their turn result. There are other instances of pædogenetic reproduction among diptera, but none so interesting as this.

This family contains some of the most destructive of all insects in man's economy, and perhaps the most important of these is *Cecidomyia* (*Mayetiola*) *destructor*, commonly called the Hessian Fly, from the belief, probably erroneous, that it was first introduced into this country in straw brought by Hessian troops during the Revolution.

The fly is very small, but little more than an eighth of an inch in length, of a prevailing black color, with the abdomen pinkish or brownish. There are two broods, in spring and autumn. The female deposits her eggs, one or two at a time, on the upper side of the leaves of wheat, to the number of from eighty to a hundred, or even more. Hatching in from four to eight days, if the weather is favorable, the yellowish red larvæ crawl downward on the leaves until they insert themselves between the leaf and the stalk. Here they remain quiescent, growing by means of imbibition or absorption of the juices of the plant, until they reach the size of a small grain of rice. The larvæ that are hatched in April, in a few weeks assume the pupa state, called the flax-seed stage. In August the second brood appears, the female of which deposits her eggs in young winter wheat or other grain, where the larvæ soon hatch and acquire the flax-seed condition in a few weeks, or by November, in which condition they

pass the winter. In England there is but one brood, that of early summer, and the fly is not nearly so injurious to growing grain.

I give two tables of the genera. The first is that of the previous edition of this work with minor modifications, and is nearly that of Wulp, Schiner, Winnertz and H. Loew, with additions. The figures illustrating these principal groups are, for the most part, taken from Wulp, and are of typical forms in the sense of Kieffer. In addition I give a transcription of Kieffer's table as published by him in 1898 (Bull. Soc. d'Hist. Nat. Metz.), with certain abbreviations, especially of those characters derived from the structure of the genital organs, characters which I view with suspicion; and I have modified his terminology in accordance with the true conception of the dipterous venation, since Kieffer's terminology is only a makeshift, not based upon comparative studies, Some of Kieffer's genera are evidently founded upon characters which would have been considered of generic value by the older writers, but, for the most part, they are merely permutations of what have, hitherto, been considered as specific characters, and I am convinced that some of them, as he defines them, are in a high degree artificial. One should always be suspicious of characters which permit perfectly parallel subdivisions in parallel phyla, for one must be assured that the characters selected for primary subdivisions are not really homoplastic and of secondary importance, and it is apparent that some other writer with different views of the relative importance of these characters might properly revolutionize the whole system. Furthermore, it will be apparent that Kieffer in some places ignores as of slight or minor value characters which in other places he raises to higher rank. His 'pelote unique', 'trois pelotes', 'crochets bifides' and 'crochets simples', as well as the

never ending permutations of palpal and antennal joints, are repeatedly used and according to his view are wholly homoplastic characters, while it is seriously to be considered whether many of them are not of real genetic origin, and consequently untenable in their subdivisional and repeated uses. Older writers had recognized many, if not most of these characters, but had refrained from using them.

In other words, I consider the present classification offered by Kieffer as largely artificial and consequently not permanent. But the table will call the attention of the student to many minor characters which he would otherwise be very apt to overlook.

I do not accept the contention of Karsch, with which I have long been familiar, that the names *Cecidomyia* and *Diplosis* should be differently applied or abandoned. Nor can I agree with Professor Aldrich that these changes have been threshed out in Europe. I can find no writer whose opinion is authoritative who has accepted them, nor did Kieffer. On the contrary Osten Sacken, whose opinion I value more than that of any other recent writer, has steadily opposed not only these changes, but the apparently unnecessary reduplication of the genera, for it must be remembered that Kieffer alone has proposed and adopted about fifty new 'genera'. Hendel, in reply to Osten Sacken's objections, has said that genera exist in nature, and that all we have to do is to recognize them—a remarkable declaration from a naturalist of the twentieth century. I suppose he would permit 'Nature' to occasionally revise its genera *a la* De Vries! While it is true that the typical species of Meigen's genus *Cecidomyia* is not included in that genus as accepted by Loew and in this work, but is included under *Diplosis*, it is also true that rigid rules of priority can not be extended to the works of many of the early writers. If

they are, not a few other revolutions of a similar character would impend, notably that of the genus *Milesia*, as I have made clear in my Synopsis of the North American Syrphidæ.

In brief, the classification, or rather the nomenclature of this family is still in a more or less chaotic condition, and will be so until much more study has been given to the insects, especially those of America and Asia. As Aldrich has said, there is no more fertile field in all dipterology for thorough, exhaustive, ethologic, morphologic, taxonomic and phylogenic studies than among the Cecidomyidæ. But there are many difficulties in their study. Doubtless if Kieffer's principles of generic subdivision are accepted, there are a host of new 'genera' to be discovered in North America, for the permutations of antennæ, palpi and tarsi are by no means exhausted. My advice is, however, for the non-specialist to go very slowly indeed in adding to what may prove to be an already unnecessary confusion.

TABLE OF GENERA.

(For the most part in their wider sense.)

Fourth longitudinal vein wanting. . . . **Cecidomyinæ.**
Fourth longitudinal vein present (ocelli present). **Lestreminæ.**

CECIDOMYINÆ.

1. First tarsal joint shorter than the following one. . . 2
   First tarsal joint longer than the following one. . . . 14

2. Fifth longitudinal vein not furcate. (8). . . **Spaniocera.**
   Fifth longitudinal vein furcate. 3

3. First and third longitudinal veins approximated to the costa, distinguishable with difficulty; costa tomentose. . . . 4
   Third longitudinal vein distinctly separated from the first. 6

4. Fifth longitudinal vein furcate near the middle. . . 5
   Fifth longitudinal vein furcate at base, giving an appearance of two longitudinal veins. (See DD, p. 127.)

5. Proboscis much elongated, directed downward. **Clinorhyncha.**
   Proboscis short (1). . . . . **Lasioptera.**

6. Antennæ bead-like, the joints verticillate. . . . 7
   Antennæ cylindrical, the joints approximated, not petiolate, provided with short, close hairs; the third vein terminates at or beyond the tip of the wing. . . . **Asphondylia.**

7. The third longitudinal vein terminates in the costa before the tip of the wing (3), ... **Cecidomyia.**
   The third vein terminates in the costa at or beyond the tip of the wing. 8

8. Thorax highly arched, hood-like over the head (4). **Hormomyia**
   Thorax only moderately arched. 9

9. Wings with but three longitudinal veins, the first, third and fifth. 10
   Wings with apparently four longitudinal veins, that is the first, third and, two in place of the fifth, the furcation taking place so near the root of the wings as to give the appearance of an additional longitudinal vein. 13

10. The anterior cross-vein, that is the vein arising from the root of the wing and connecting with the third vein nearly where it arises from the first, is curved S-shaped. 11
    The anterior cross-vein is nearly straight, apparently the beginning of the third vein. 12

11. Wings very long and narrow (10). . . . **Colpodia.**
    Wings not more than three times as long as wide (2). **Epidosis**

12. Joints of the antennal flagellum petiolate, in the male with two bead-like swellings on each joint (14). . . **Diplosis.**
    Joints not petiolate, or at most the males with a single bead-like swelling on each joint. . . . . **Dirhiza.**

13. Palpi large, with the last joint elongated, anterior cross-vein S-shaped. . . . . **Asynapta.**
    Palpi small, the last joint not or but little longer than the penultimate; anterior cross-vein but little curved (13). **Winnertzia.**

14. Wings with but two longitudinal veins, the first and fifth, the latter not reaching beyond the middle of the wing (11).
    Heteropeza.
    Wings with three longitudinal veins, the first, third and fifth. 15

15. Fifth vein furcate. 16
    Fifth vein simple, not furcate (7). . . . . **Miastor.**

16. First and third veins approximated (*Diomyza*). **Lasiopteryx.**
First and third veins not approximated (5). **Trichopteromyia.**

LESTREMINÆ.

1. Fourth longitudinal vein simple. 2
Fourth longitudinal vein furcate; the two branches of the fifth, when present, are divergent at base of the wing, giving the appearance of longitudinal veins. 4

2. Fifth longitudinal vein furcate near base. . **Strobliella K.**
Fifth longitudinal vein furcate near its middle (*Joannisia* K., *Peromyia* K., *Wasmaniella* K., *Bryomyia* K., *Prionellus* K., *Aprionus* K., *Monardia* K.) 3

3. Antennæ composed of from fourteen to twenty-five joints, the joints petiolate in the male. . . . **Campylomyza.**
Antennæ composed often (male), or six or eight (female) joints, the joints petiolate in neither sex. . . **Micromyia.**

4. The costal vein reaches to or exceeds the tip of the wing. **Catocha**
The costal vein does not reach the tip of the wing (9). . 5

5. Only one vein behind the forked cell. . . . **Tritozyga.**
Two veins behind the forked cell (6). . . . **Lestremia.**

TABLE OF GENERIC DIVISIONS (Kieffer).

CECIDOMYINÆ.

A. First joint of tarsi shorter than the second; wings rounded at extremity; no ocelli.
B. Wings with squamæ on anterior border; claws bifid.
C. First two longitudinal veins very close to the costa.
D. Three longitudinal veins, the first, third and fifth, the fifth furcate near the middle.
1. Proboscis short. . . . . **Lasioptera.**
2. Proboscis elongate. . . . **Clinorhyncha.**
DD. Four longitudinal veins, that is the fifth is divided near base of wing.
3. Thorax attenuated at neck. . **Acorhynchus R.**
4. Palpi with one joint. . . . **Baldratia K.**
5. Palpi with four joints. . . **Choristoneura L.**
CC. Third longitudinal vein, at least, remote from costa.
E. Empodia simple.
6. The third longitudinal vein terminates at or near extremity of wing. . . . **Cecidomyia.**
7. The third longitudinal vein terminates at some distance before tip of wing. . . **Perrisia** Rond.
8. Flagellar joints with two verticils; alike in both sexes. **Macrolabis K.**

EE. Empodia trifid.*

9. Antennæ composed of twelve joints in both sexes. **Arnoldia** K.

10. Joints of antennæ more numerous in male than in female; last abdominal segment not swollen. **Dryomyia** K.

11. Antennæ composed of more than twelve joints; last abdominal segment swollen (♀). . . **Dasyneura.**

BB. Anterior border of the wings without squamæ; claws simple.

F. Empodia simple.

12. Palpi with four joints; antennæ fourteen-jointed, verticillate. . . . . **Schizomyza** K.

13. Palpi four-jointed; antennæ fourteen-jointed, not verticillate. . . . . **Polystepha.**

14. Palpi three-jointed; costa with squamæ. **Cystiphora** K.

15. Antennæ fourteen-jointed, not verticillate; palpi with less than four joints. . . . **Asphondylia.**

FF. Empodia trifid; antennæ verticillate.

16. Palpi with one or two joints. . **Rhopalomyia** R.

17. Palpi with three joints. . . **Oligotrophus** Lat.

18. Palpi with four joints, long. . . . **Janetiella** K.

19. The second vein reaches the tip of the wing, palpi with four joints. . . . . **Mayetiola** K.

20. Palpi with four long joints. . . . **Mikiola** K.

21. Thorax produced over head. . . **Hormomyia.**

BBB. Thorax not prolonged over the head; antennæ fourteen-jointed in both sexes; in the male each joint of the flagellum with two bead-like swellings, giving an appearance of twenty-six joints for the antennæ.

G. Claws of front tarsi bifid, or curved at right angle and enlarged at extremity; or the empodium trifid.

22. Empodia trifid. . . . . **Putoniella** K.

23. Verticils of antennæ curved and irregular; larvæ zoophagous. . . . . **Bremia** Rond.

24. Verticils regular; all the claws bifid. **Dicrodiplosis** K.

25. Verticils regular; hind claws not bifid; larvæ mycophagous, ... **Mycodiplosis** R.

26. Claws simple, bent at right angles and dilated below near extremity. . . . **Octodiplosis** Giard.

GG. Claws simple, bent or curved at right angles, but not enlarged; empodia simple.

27. Three-jointed palpi; scales of wings elongated and narrowed at base. . . . . **Endaphis** K.

28. Second longitudinal vein terminates before the tip of the wing; larvæ zoophagous. . **Arthrocnodax** Rbs.

29. Palpi with a single joint. . **Monarthropalpus** R.

30. Palpi two-jointed, the first long and attenuated in the middle. . . . . **Massalongia** K.

31. Palpi with three joints; second joint of antennæ with a tooth. . . . . **Acrodiplosis** K.

* I use this expression, not being certain whether or not the trifid character is due to real pulvilli. Kieffer simply begs the question by the expression 'pelote unique,' 'pelotes trois'.

32. Palpi with three joints; empodia longer than claws. **Stenodiplosis** Rent.
33. Palpi with four joints; empodia shorter than claws. **Contarinia** R.
34. Costal vein not interrupted after its junction with third longitudinal vein. . . . **Thecodiplosis** K.
35. Male antennæ with swellings alternately simple and double; ovipositor very long. **Xylodiplosis** K.
36. Ovipositor not longer than body; costal vein not interrupted beyond third vein; empodia one-half the length of claws. . . . . **Loewiola** K.
37. First two joints of flagellum not fused; empodia nearly as long as claws. . . . **Macrodiplosis** K.
38. Enlargements of male antennæ irregular, alternately double and single; empodia longer than claws; first two joints of flagellum fused. . . **Harmandia** K.
39. Enlargements of male flagellum irregular, alternately double and single; empodia shorter than claws; ovipostor not prominent. . . . **Clinodiplosis** K.
40. Wings usually spotted; larvæ zoophagous. **Lestodiplosis** K.
41. Joints of male flagellum alternately single and double; costal vein interrupted after junction with third vein; empodia longer than claws. . . . **Diplosis.**

BBBB. Anterior cross-vein present and curved, apparently the beginning of the third vein; the longitudinal always terminate at or beyond the tip of the wing.

42. Three longitudinal veins, the first, third and fifth; anterior transverse not parallel with first vein. **Bryocrypta** K.
43. Anterior cross-vein curved in form of an S (first joint of the tarsi prolonged below at extremity). **Colpodia.**
44. Anterior cross-vein not curved in form of an S; fifth vein not furcate; palpi with two joints; claws bifid. **Colomyia** K.
45. Palpi with four joints; claws simple; empodia simple. **Holoneurus** K.
46. Fifth vein furcate. . . . . **Dirhiza.**
47. Flagellar joints petiolate; fifth vein furcate. **Epidosis.**
48. Like *Epidosis*, abdomen slender. **Camptomyia** K.
49. Fifth vein furcate at base of wing; claws simple; empodia simple. . . . . **Ruebsaamenia** K.
50. Like *Ruebsaamenia*, abdomen not recurved; empodia trifid, claws simple. . . . **Clinorhytis** K.
51. As in *Clinorhytis*; antennæ with more than fourteen joints; empodia simple; claws bifid. **Asynapta** Lw.
52. Like preceding, claws bifid, empodia simple; antennæ with fourteen joints. . . . **Winnertzia.**
53. Neuration as in *Clinorhytis*, second vein arises near base. . . . . **Diallactes** K.

HETEROPEZINÆ.

AA. 54. Two joints in the tarsi, the first shorter than the second; no palpi; with two or three longitudinal veins. **Oligarces** Mein.

55. Tarsi with three joints, the first longest; two longitudinal veins. . . . . **Heteropeza.**

56. Tarsi with four joints, first longer than second; three longitudinal veins; palpi with two joints. **Miastor** Mein.

57. Tarsi with five joints, first shorter than second; wings acuminate at extremity; palpi three-jointed; three longitudinal veins. . . . . **Pero** Mein.

58. Like preceding, palpi two-jointed, third longitudinal vein evanescent before extremity. . . . **Firenia** K.

59. Like *Firenia;* palpi single jointed. . **Leptosyna** K.

60. Tarsi with five joints, the first longer than second; scales of wings long and striated. . . **Lasiopteryx** W.

61. Like preceding, but tarsi with four joints and neuration as in *Perrisia.* . . . . . **Ledomyia** K.

62. Like *Ledomyia*, but first joint of tarsi shorter than second; fifth vein simple. . . . **Brachyneura** Rond.

LESTREMINÆ.

AAA. First joint of tarsi longer than the second; fourth longitudinal vein present.

H. Fourth vein simple; fifth furcate near its middle.

63. Flagellum in the male with twelve joints, in the female with nine; palpi with three or four joints; claws simple. **Joannisia** K.

64. Male flagellum with twelve, female with eleven, palpi with two joints. . . . . **Peromyia.**

65. Claws denticulate; no empodia; antennal joints long-petiolate. . . . . **Wasmaniella** K.

66. Claws as in *Peromyia;* palpi four-jointed; antennæ as in *Prionellus.* . . . . . **Bryomiya** K.

67. Claws denticilate; empodia large; flagellar joints of male antennæ excentric. . . . . **Prionellus.**

68. Like *Prionellus*, but the claws not denticulate, and the empodia short or rudimentary. . . **Aprionus** K.

69. Like *Aprionus* but the claws denticulated. **Monardia** K.

70. Antennæ very short, composed of ten or eleven joints in the male and from six to eight in the female; joints not petiolate in either sex. . . . **Micromyia** R.

71. Antennæ with about twelve flagellar joints in the male, from ten to twenty-three in the female. **Campylomyza**

VII. Family MYCETOPHILIDÆ.

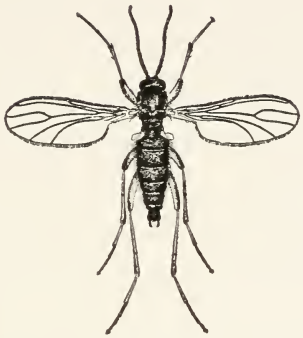


Fig. 39. *Sciara*, sp. Enlarged. After Washburn.

Mostly small, delicate, slender flies, with more or less elongated coxæ. Head small, rounded or somewhat elongate. Eyes round, somewhat prominent; ocelli two or three in number, when only two, placed one on each orbital margin; rarely apparently wholly wanting; when three in number, placed transversely in the form of a shallow triangle. Front broad in both sexes. Antennæ elongated, curved, twelve to seventeen-jointed, the two basal joints differentiated, the remainder cylindrical, flattened, or petiolated. Proboscis rarely elongated: palpi three or four-jointed, usually inflected, the first joint small; occasionally absent. Thorax more or less, sometimes highly arched, without transverse suture; metanotum large; scutellum small. Abdomen elongated, composed of six or seven segments, cylindrical or compressed, sometimes narrowed at the base; male genitalia projecting forceps-like; ovipositor pointed, usually with two terminal lamellæ. Legs more or less elongated, the coxæ

more or less, sometimes much elongated; femora more or less dilated, tibiæ with spurs. Wings large (wanting in the ♀ of *Epidapus*); auxiliary vein present, though sometimes rudimentary; second longitudinal vein wanting; the third vein arises from the first usually at such an angle that its first section (to the anterior cross-vein) has the appearance of a cross-vein; fourth vein always, the third* and fifth either furcate or not; sixth vein never furcate, sometimes rudimentary; seventh vein usually short, often rudimentary or entirely wanting; discal and posterior basal cells always wanting.

The family Mycetophilidæ, commonly known as fungus-gnats, comprises nearly a thousand described species of small or minute flies, the best known of which are, perhaps, the various dark-winged species of *Sciara* so common about gardens. In the following description of the immature stages I draw largely from Osten Sacken.

The larvæ have a distinct horny head; horny, flat, lamelliform mandibles; maxillæ with a large coriaceous inner lobe and a horny outside piece, with a circular incision at the tip, the labium small, horny, almost rudimentary; the antennæ are usually small or rudimentary, the ocelli are either wanting or seen in a small pellucid spot below each antenna. The body is subcylindrical, more or less elongated, fleshy, whitish or yellowish, and composed of twelve segments. It is smooth, without hairs or bristles, except those on the ventral side. It is generally transparent, showing distinctly the intestinal canal and the trachea. There are eight pairs of stigmata, one on the first segment, and seven on the first seven abdominal segments, the last two having none. The locomotory organs consist of more or less apparent transverse

* I am of the opinion that the so-called anterior branch of the third vein is in reality a vestige of the second vein.

swellings on the under side of the ventral segments, sometimes furnished with minute bristles or spines.

The larvæ present some of the most singular habits among all diptera. They are gregarious, and live in or upon decaying matter. Most of the species seem to prefer fungus or fungoid substances, whence comes the common name of fungus-gnats applied to the mature insect. The larvæ of *Sciara* are found among decaying leaves, in vegetable mold, in cow-dung, under the bark of dead trees, etc.; they often live in the soil of potted plants. The larvæ are said to moult several times before pupating. The larvæ of many species spin delicate webs over the surface of fungi, and on this web they live until ready to pupate, when they spin a dense cocoon in sheltered spots; others live within the decaying fungi. Perhaps the strangest habits of all are those of species of *Sciara*, which are even more gregarious than other members of this family. They have the singular propensity of sticking together in dense patches, and will form processions sometimes twelve or fourteen feet in length, and two or three inches broad. The phenomenon has been observed frequently both in Europe and America, but the reason therefor is not yet well understood, though the object of migration seems to be the search for better feeding grounds. Because of this habit, the name of 'army worm' has been given to them. Yet more singular is the phosphorescent character of the larvæ of some species. The larvæ, probably of *Sciophila*, were observed by Hudson to be so luminous that 'the light of a single individual kept in a caterpillar cage may be seen streaming out of the ventilators at a distance of several feet.'

The pupæ of Mycetophilidæ are free,—that is they are not contained within the larval skin, as is so commonly the case with diptera. They are usually smooth, with the legs applied to the breast and venter, the antennæ

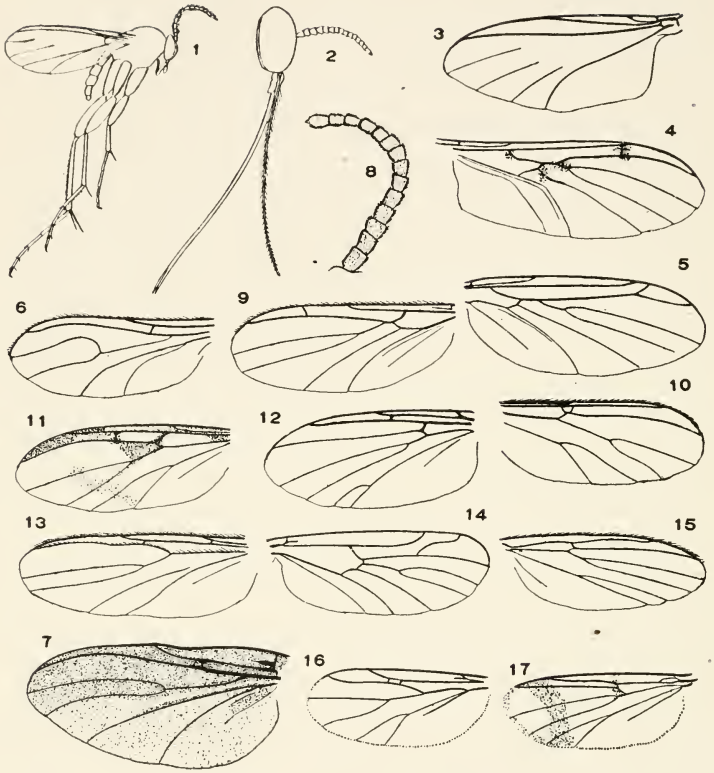


Fig. 40. Mycetophilidæ. 1, *Manota defecta;* 2, *Probolœus singularis*, head; 3, *Probolœus singularis*, wing; 4, *Macrocera concinna*, wing; 5, *Ceroplatus longimanus*, wing; 6, *Sciara zygoneura*, wing; 7, *Sciara americana*, wing; 8, *Sciara*, sp., antenna; 9, *Platyura ignobilis*, wing; 10, *Sciophila diluta*, wing; 11, *Neoempheria maculipennis*, wing; 12, *Phthinia fraudulenta*, wing; 13, *Neoglaphyroptera nitens*, wing; 14, *Plesiastina*, sp., wing; 15, *Mycetophila insipiens*, wing; 16, *Tetragoneura sylvatica*, wing (Wulp); 17, *Dynatosoma fuscicornis*, wing (Wulp).

bent around the eyes, and their remaining portion applied to the breast between the wings and the legs. The pupæ of not a few are enclosed in a cocoon of more or

less density, spun by the larvæ; others enclose themselves in earthy cases.

The study of the mature insect requires some care. Usually a compound microscope is necessary for the detection of many characters, especially of the more minute species, and generally, when there is doubt of the identity, it is best to mount the whole insect or the most important parts under a cover glass.

In America, as elsewhere, but little study has been given to this family, and hence there are doubtless not a few genera that have hitherto escaped detection. The following table has been for the most part compiled from V. d. Wulp, Winnertz and Schiner, and compared with representatives of nearly all the genera.

TABLE OF GENERA.

1. Coxæ moderately long; anterior cross-vein in the same right line with the second section of the third vein; the fifth vein forked near base of wing. . . . . **Sciarinæ.**
   Coxæ much elongated; anterior cross-vein distinctly angulated from the second section of the third vein. . . . 2

2. Only the distal part of the forks of the fourth vein visible. . 3
   Fourth vein visible in its whole extent, the anterior fork rarely incomplete proximally. 4

3. Probosois short; palpi three-jointed; ocelli distinct (1). **Manota.**
   Proboscis much elongated; no palpi; ocelli indistinct or absent (2, 3). . . . . **Probolæus.**

4. Origin of fourth vein from the fifth, near base of wing; sixth vein more or less indistinct. 5
   Origin of fourth vein opposite or beyond the origin of the third; sixth vein usually distinct. 6

5. Third longitudinal vein furcate, its anterior branch* usually so near its origin and so transverse in position that it resembles a supernumerary cross-vein; three ocelli present. **Sciophilinæ.**
   Third longitudinal vein not furcate. . . **Mycetophilinæ.**

* In reality the second longitudinal vein.

6. Third longitudinal vein not furcate. . . . **Diadocidia.**
Third longitudinal vein furcate. 7

7. Anterior branch of third vein long, terminating in the costa. **Mycetobiinæ.**
Anterior branch of the third vein short, more transverse, usually ending in the first vein. 8

8. The præfurca of the fourth vein arises from the third vein beyond the anterior cross-vein, i. e. the cross-vein is really wanting and the third and fourth veins are coalescent for a short distance. 9
The fourth vein continuous in nearly the same line from the fork to its origin from the fifth; cross-vein distinct. **Bolitophila.**

9. Antennæ short and thick-set, often flattened. . **Ceroplatinæ.**
Antennæ exceedingly long and slender, longer than the body (4). **Macrocera.**

SCIOPHILINÆ.

1. Anterior cross-vein more than twice the length of the basal section of the third vein, forming apparently the beginning of the third vein (16). . . . . **Tetragoneura.**
Anterior cross-vein shorter or but little longer than the first section of the third vein, and forming a distinct angle with the second section. 2

2. The costal vein terminates at the tip of the third vein (10). **Sciophila.**
The costal vein continues a short distance beyond the tip of the third vein. 3

3. Fork of the fourth vein short petiolate, the prefurca shorter than the anterior cross-vein. . . . . **Lasiosoma.**
Prefurca of fourth vein much longer than the anterior cross-vein. 4

4. Proximal end of the posterior furcation (fifth vein) before or opposite the anterior cross-vein (11). . . **Neoempheria.**
Proximal end of the posterior furcation beyond the anterior cross-vein. . . . . **Polylepta.**

MYCETOBIINÆ.

1. Auxiliary vein complete; the anterior branch of the third vein arises at a point where the third vein and the anterior cross-vein unite. **Mycetobia.**
Auxiliary vein rudimentary, not terminating in the costa; furcation of third vein petiolate. 2

2. Furcation of third vein more proximad than that of the fourth. **Ditomyia.**
Furcation of fourth vein more proximad than that of the third (14) **Plesiastina.**

CEROPLATINÆ.

1. Face and proboscis prolonged, snout-like. . **Asindulum.**
Face and proboscis not produced. 2

2. Antennæ shorter than the head and thorax, flattened; palpi short (5). . . . . **Ceroplatus.**
Antennæ more elongate, cylindrical; palpi moderately long (9). **Platyura.**

MYCETOPHILINÆ.

1. Three ocelli present. 4
Two ocelli, one situated near the margin of each eye. . . 2

2. The costal vein is continued beyond the tip of the third vein. **Eudicrana.**
The costal vein reaches only to the tip of the third vein. . 3

3. Auxiliary vein vestigial, projecting only a short distance beyond the humeral cross-vein; furcations of fourth and fifth veins nearly opposite each other (15). . . . **Mycetophila.**
Auxiliary vein complete, longer than the humeral cross vein; ending in first vein (17). . . . . **Dynatosoma.**

4. Auxiliary vein complete, terminating in the costa. . . 5
Auxiliary vein not terminating in the costa, rudimentary or terminating in the first vein. 12

5. Proboscis much elongated . . . . . **Gnoriste.**
Proboscis short. 6

6. Auxiliary vein connected by a small cross-vein with the first longitudinal. 7
Auxiliary vein not connected by a cross-vein with the first longitudinal. . . . . **Leia.**

7. Fifth vein furcate. 8
Fifth vein simple, not furcate. . . . . **Acnemia.**

8. Origin of the third vein perceptibly past the middle of the wing, the anterior cross-vein longer than the distal section of the first vein (13). . . . . **Neoglaphyroptera.**
Origin of the third vein distinctly before the middle of the wing, the anterior cross-vein much shorter than the distal section of the first vein. 9

9. Upper branch of the fork of the fourth vein incomplete at the base; third vein sinuous (*Odontopoda*). . . . **Anaclinia.**
Fork of fourth vein complete; third vein not markedly sinuous. 10

10. Furcation of the fifth vein before or opposite the furcation of the fourth. 11
Furcation of the fifth vein distinctly more distal than that of the fourth (12). . . . . **Phthinia.**

11. The costal vein continues beyond the tip of the third vein; abdomen cylindrical. . . . . **Boletina.**
The costal vein terminates at the tip of the third vein; abdomen compressed. . . . . **Leptomorphus**

12. Auxiliary vein elongated, terminating angularly in the first vein, near the origin of the third. . . . . **Syntemna.**
Auxiliary vein vestigial or ending acutely in the first vein before the origin of the third. 13

13. Fifth longitudinal vein not furcate . . . **Zygomyia.**
Fifth longitudinal vein furcate. 14

14. The costal vein extends a little beyond the termination of the third vein. 15
The costal vein terminates at the tip of the third vein. . 17

15. Forked cell of the fifth vein acute proximally, the branches gradually and but little divergent. . . . . **Epicypta.**
Forked cell of fifth vein less acute proximally, the branches more widely and rapidly divergent, the upper branch curved. 16

16. Auxiliary vein of considerable length, terminating in the first vein. **Docosia.**
Auxiliary vein short, ending free a little beyond the humeral cross-vein. . . . . **Phronia.**

17. Auxiliary vein reaching beyond middle of first basal cell, and terminating in first vein. . . . . **Trichonta.**
Auxiliary vein vestigial, or not reaching as far as the middle of the first basal cell. 18

18. Furcation of the fourth vein before the first section of the third vein. 19
Furcation of fourth vein beyond the first section of the third vein. 20

19. Furcation of fifth vein more distal than that of the fourth. **Exechia.**
Furcation of the fourth vein more distal than that of the fifth. **Rhymosia.**

20. Furcation of the fifth vein more distal than the junction of the fourth with the anterior cross-vein. 21
Furcation of the fifth vein more proximal than the junction of the fourth with anterior cross-vein. . . **Brachycampta.**

21. Furcation of fifth vein more distal than that of the fourth. **Mycothera.**
Furcation of fourth vein more distal than that of the fifth. **Allodia.**

SCIARINÆ.

1. Wings and halteres wholly wanting. . . **Epidapus ♀.**
Wings and halteres as usual. 2

2. The fourth vein springs from the third at an angle, i. e. the anterior cross-vein is obsolete. . . . . **Epidapus ♂.**
Anterior cross-vein not obsolete. 3

3. Proboscis much elongated, longer than the thorax. **Eugnoriste.**
Proboscis short. 4

4. Wings very distinctly hairy; claws not denticulate. **Trichosia.**
Wings bare or slightly hairy. 5

5. Antennal joints of male pedicillate and with whorls of hair; forks of fourth vein arcuate. . . . . **Zygoneura.**
Antennal joints not pedicillated, bare or with short hairs. . 6

6. Claws denticulate. . . . . **Odontonyx.**
Claws not denticulate. 7

7. Face strongly produced. . . . . **Rhynchosciara.**
Face not produced. . . . . **Sciara.**

Additional Generic References.

Odontonyx Ruebsaamen, Berlin. Ent. Zeit. xxxix, 25, 1894. Mexico.

Rhynchosciara Ruebsaamen, l. c. Mexico.

VIII. Family BIBIONIDÆ.

Fig. 41. *Bibio albipennis*, enlarged. After Washburn.

Moderately or very slender flies, of from one to twelve millimeters in length. Head usually somewhat flattened; front in the male usually very narrow or the eyes contiguous; face short; eyes round or reniform; ocelli large, distinct ('absent in *Hesperodes*'). Antennæ composed of from eight to sixteen joints, cylindrical or a little flattened, rarely longer than head and thorax, the joints usually closely united. Proboscis never much elongated, with thickened, hairy labella; palpi variable, three to five-jointed, sometimes long, at other times short. Thorax without suture; scutellum half round. Abdomen composed of from seven to nine segments, sometimes elongated. Legs moderately long and strong, the hind pair more or less elongated, the front femora often thickened; front tibia often with a stout hook or coronet of spines at the tip; pulvilli and empodium usually distinct, but the former in many of the smaller forms wanting. Wings large, the anterior veins often stouter than the posterior ones; costa not extending on the posterior margin;

second longitudinal vein wanting, the third arising from the first; third vein sometimes furcate;* fourth usually furcate; first basal and often the second basal cells complete; anal cell rarely closed; posterior cross-vein always wanting.

The relationships of this small family of nematocerous flies are very close with the Mycetophilidæ through the Pachyneurinæ and Scatopsinæ; indeed there is greater difference between some genera included in the family than between the families themselves. One of these annectant genera is *Hesperodes* described a few years ago by Coquillett. Because of the presence of a distinct second basal cell, and the resemblance of its venation to *Hesperinus*, it would seem better placed here than among the Mycetophilidæ, where its author placed it. A glance, however, at the different types of venation in the figures will show how composite a group the family is, as at present recognized.

Such larvæ as are known are cylindrical, footless, with transverse rows of bristles, usually with eyes; they feed upon excrementitious or vegetable substances, especially on the roots of grass. The pupæ are inactive, for the most part free, living in excavated, smooth oval cavities near the surface of the ground, which the larvæ have prepared before undergoing their metamophosis, and where the pupæ remain before emerging in the perfect state.

In some species the male flies differ very noticeably in coloration from the females, so much so that they are commonly mistaken for different species. Some of the species, especially *Bibio albipennis*, are very abundant in early spring, in meadows, about willows, upon the win-

* The anterior branch is in reality the second vein.

dows, etc. They are all rather sluggish in flight, and the males are conspicuous because of the very large and hairy eyes. Some of the species of *Scatopse* are very minute, among the smallest of all diptera. But very little has been done in the way of critical study of the genera and species of this family; it is an excellent field for research.

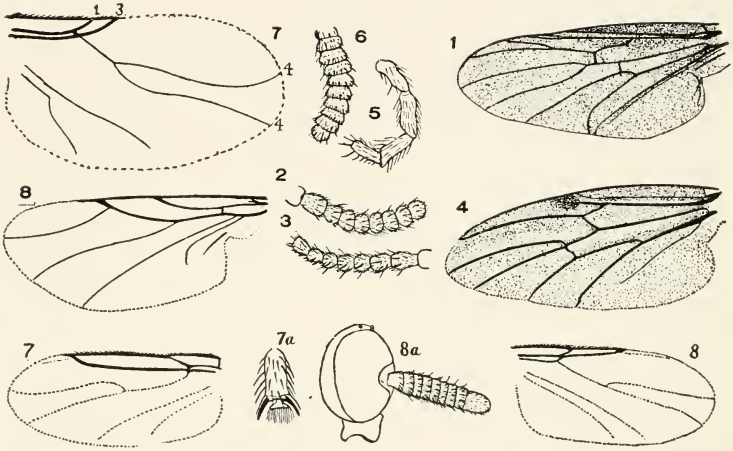


Fig. 42. Bibionidæ. 1, *Plecia*, wing; 2, 3, *Plecia*, antennæ; 4, *Bibio*, wing; 5, *Bibio*, palpus; 6, *Bibio*, antennæ; 7, *Scatopse*, wing; 8, *Aspistes*, wing (Wulp); 7, bis, *Scatopse*, wing; 7a, *Scatopse*, last tarsal joint with claws and empodium; 8, bis, *Scatopse*, wing; 8a, *Scatopse*, head.

TABLE OF GENERA.

1. Second basal cell present. 2
   Second basal cell wanting (*Scatopsinæ*). 7

2. Third longitudinal vein furcate. 3
   Third vein not furcate. 5

3. Palpi four-jointed; antennæ slender, more than ten-jointed; slender species (*Pachyneurinæ*). 4
   Palpi five-jointed; antennæ eight or nine-jointed; less slender species (**1, 2, 3**). . . . . **Plecia,**

4. Antennæ twelve-jointed; anterior cross-vein distinct.
Hesperinus.
Antennæ sixteen-jointed; anterior cross-vein obsolete, that is the third and fourth veins are coalescent for a short distance.
Hesperodes.

5. Front tibiæ with a stout spine-like process at tip, . . . 6
Front tibiæ with a coronet of spines; antennæ ten or eleven-jointed.
Dilophus.

6. Anterior cross-vein distinct; antennæ ten-jointed (**4, 5, 6**).
Bibio.
Anterior cross-vein obsolete; antennæ ten-jointed (?). **Bibiodes.**

7. Front tibiæ ending in a spine-like process; antennæ twelve-jointed. (**8**). . . . . **Aspistes.**
Front tibiæ of the usual structure; antennæ nine or ten-jointed (**7**, **7** bis. **7**a, **8** bis, **8**a). . . . . **Scatopse**).

IX. Family SIMULIIDÆ.

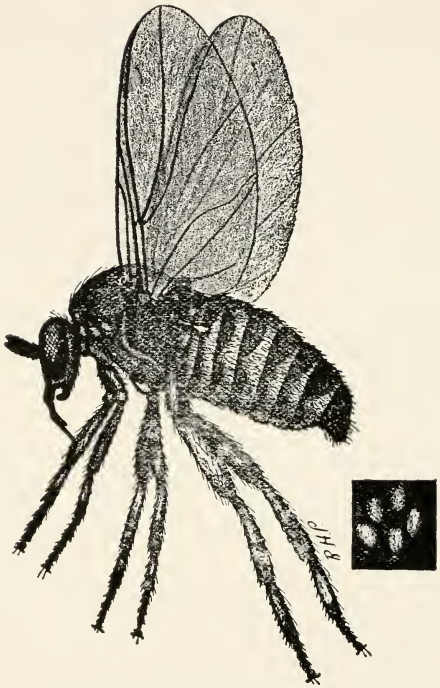


Fig. 43. *Simulium venustum;* enlarged. After Washburn.

Small flies, from one to six millimeters in length, with thick, short legs. Head hemispherical; face short; eyes round or reniform, holoptic in the male; no ocelli. Antennæ scarcely longer than the head, flattened or cylindrical, ten-jointed; the two basal joints differentiated, the others closely united. Proboscis not elongated, with small, horny labella; palpi incurvate, four-jointed; the

first joint short and the two following of equal length; the last one longer and more slender than the preceding. Thorax arched, without suture; the scutellum small. Abdomen cylindrical, composed of seven or eight segments; genitalia concealed; legs strong and not elongated; femora broad and flat; tibiæ usually with terminal spurs; first joint of the tarsi longer than the following and usually dilated in the male; the last joint small. Wings large and broad, with distinct alulæ, anterior veins thickened, the others slender; auxiliary vein terminating in the costa about the middle of the wing; second longitudinal vein wanting, the first and third lying close to each other; the third arising from the first rectangularly before the end of the auxiliary vein; anterior cross-vein very short; fourth vein curved, forked nearly opposite the anterior cross-vein; the forks terminating near the tip of the wing.

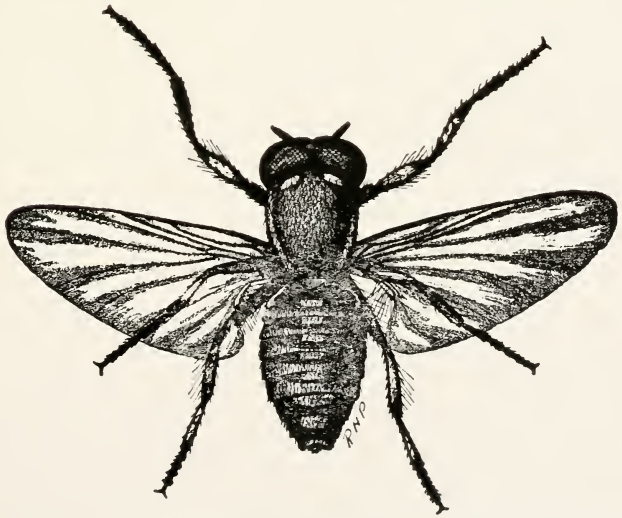


Fig. 44. *Simulium venustum*, enlarged. After Washburn.

The family Simuliidæ, comprising about seventy-five described species, is one of the best known popularly among diptera, on account of the troublesome character of the flies, which are scarcely less annoying than the true mosquitoes; they rarely exceed five or six mm. in length, usually not more than three or four, and will be immediately distinguished from the mosquitoes by their thick-set appearance, their shorter legs, their shorter proboscis, and less slender antennæ. In the southern States they are known as 'buffalo gnats' and 'turkey gnats', and sometimes occur in almost incredible numbers; cattle when attacked by large numbers are driven almost frantic, and will seek to evade them by rolling in the dust, rushing about, or going into the water. When the flies are numerous they will almost literally cover the cattle, especially seeking the openings of the body, entering the nostrils and the ears, the margins of the eyes, where they will actually lie piled upon each other. When very numerous they will produce an inflammatory fever, frequently terminating in death. Infants have been known to succumb to their bites. The well known European species is *S. columbaczense*, which during some seasons in the regions of the Danube costs the death of many cattle.

The larvæ are very interesting creatures; they are aquatic, living most frequently in mountain streams, on stems of plants, or stones, where they form for themselves elongated cocoons, opened above. In the open end of these cocoons the pupæ ensconce themselves with the anterior part of the body naked and free, from which extend eight or sixteen very long, slender, threadlike breathing tubes. The perfect insect escapes under water and comes to the surface. The larvæ are soft-skinned, thickened at the extremities, with a cylindrical head, two pairs of eye-spots; on the first thoracic segment there

is a foot protuberance with bristly hooklets; and the end of the abdomen has several appendages for attachment.

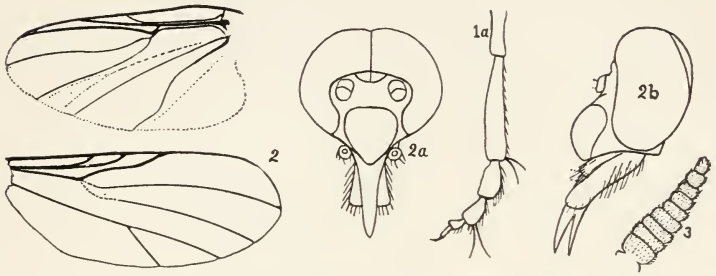


Fig. 45. Simuliidæ. *Simulium*, wing; 1a, *Simulium*, front tarsus; 2, genus nov., wing; 2a, id. head, front view; 2b, id. head, side view; 3, *Simulium*, antenna.

But a single genus, *Simulium*, has hitherto been known in this family. What seems to be a distinct genus has long been known to me in a single imperfect specimen from the West Indies. The form will, I hope, be recognizable from the accompanying illustrations made by me many years since. (2, 2a, 2b). The specimen is exceedingly minute, and was discovered closely applied to and sucking the juices from the antenna of a phasmid. The antennæ and palpi are mostly wanting in the specimen.

X. Family BLEPHAROCERIDÆ.

BY PROF. V. L. KELLOGG.

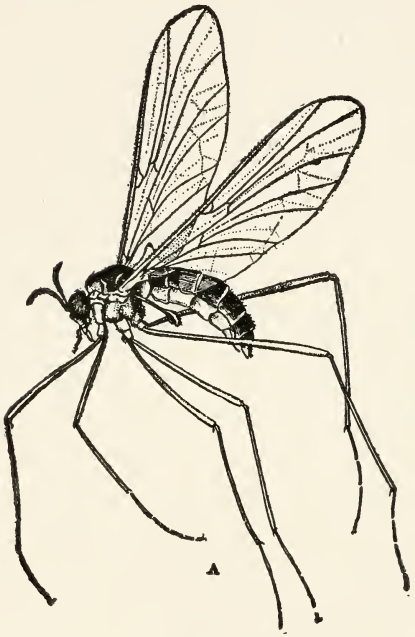


Fig. 46. *Bibiocephala elegantula*, enlarged. After Kellogg.

Moderate-sized, elongate, bare species with long legs and broad wings. Eyes usually dichoptic in both sexes, but occasionally holoptic in one or both sexes; eyes of both sexes usually bisected by a line or narrow unfacetted space, with the two fields composed of larger and smaller ommatidia (indicated by larger and smaller corneal facts), in a few species the eyes bisected only in one

sex. Three ocelli present. Antennæ slender with from nine to fifteen segments, clothed with short pubescence. Mouth-parts elongate, females with slender, flattened, elongate, saw-like mandibles, males without mandibles; both sexes with slender elongate labrum-epipharynx, hypopharynx, and a pair of maxillæ with five-segmented palpi; labium with a strong, elongate basal sclerite and a pair or free, fleshy terminal lobes without pseudo-tracheæ, and with no palpi. Thorax with a distinct, broadly interrupted transverse suture; legs moderately slender, the hind pair much longer than the anterior ones, the front femora of males curved in some species, tibiæ with or without spurs; empodia very small, almost rudimentary, pulvilli wanting; wings broad, bare, with a markedly projecting anal angle, and peculiarly different from those of all other flies in the possession of a fine spider-web like net-work of lines ('secondary venation') which are the creases made by the folding of the wings in the pupal stage.

The larvæ are curious, flattened, slug-like creatures, legless, but provided with six suckers arranged in a medial longitudinal row on the venter (one sucker for each of the six parts separated by constrictions of the body, of which the anterior part is composed of the fused head and thoracic segments, and the posterior part of the fused last two abdominal segments, the other four parts representing each a single abdominal segment). The larvæ live in swiftly running, shallow, clear and highly aerated water (mountain brooks) clinging by the suckers to the smooth surface of boulders or the rock bed of the stream. The pupæ are even more extraordinarily shaped, being flat below and flatly convex above with strongly chitinized, dorsal body-wall smooth and shining black or blackish brown, with a pair of projecting prothoracic dorsal respiratory horns or 'books', each com-

posed of four flattened leaves, two of them delicate tracheal gills and the other two protecting chitinized plates. The pupæ are fastened by three pairs of pads on the flat venter to the rock-bed or boulders in the swift stream and are nonmobile.

The delicate adults are to be found, usually only rarely, despite the oft-time abundance of larvæ and pupæ, clinging to rocks projecting from the stream or to streamside cliffs or foliage. The females are predaceous and may be seen flitting about capturing small flies, especially Chironomidæ, which they lacerate with their saw-like mandibles and knife-like maxillæ in order to suck or lap up the blood. The males are rarely found. A few species are known as yet only in the larval and pupal stages. The egg-laying habits are unknown.

The family Blepharoceridæ was established by Loew in 1860 to include a half dozen species, which could not well be located in any of the existing families. Since that time the number in the family has been increased to about twenty known forms included in nine genera, of which three genera, represented by eight species, are found in the United States. Our species are recorded

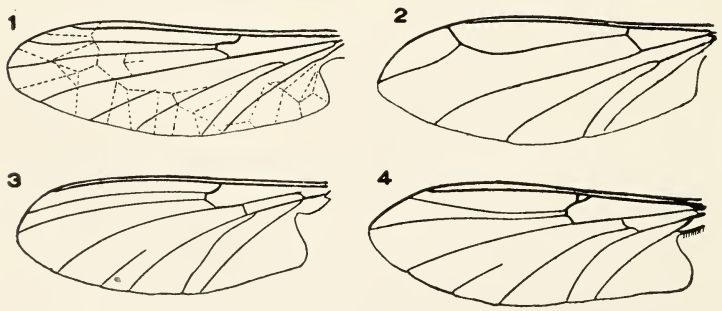


Fig. 47. Blepharoceridæ. 1, *Blepharocera*, wing, showing secondary venation (Comstock); 2, *Paltostoma schineri*, wing; 3, *Philorus*, wing (Kellogg); 4, *Bibiocephala*, wing (Kellogg).

from Canada, New York, Colorado, New Mexico, Idaho, Utah and California. The foreign species are found in Europe, Asia, South America and certain Mediterranean islands.

The family is readily divisible into two groups, of which one, characterized by the absence in its members of a short, incomplete vein near the posterior margin of the wing, includes six genera, nearly all of which are represented by a single species, and none of them occurring in North America, north of Mexico. The remaining known species are grouped according to the latest revision of the family (Kellogg, 1903) into three genera represented in Europe by about six species and in America by eight.

TABLE OF GENERA.

1. No incomplete vein running into hind border of the wing (*Apistomyia*, Corsica; *Hammatorhina*, Ceylon; *Kelloggina*, Brazil; *Curupira*, Brazil; *Hapalothrix*, Europe). Proboscis elongated; hind tibiæ with spurs; eyes entire, not bisected (2). **Paltostoma.**

An incomplete vein near the posterior margin of the wing. . 2

2. Second longitudinal vein with an anterior branch; a cross-vein connecting the fourth and fifth veins, that is, the second basal cell complete. Anterior branch of second vein and the second and third veins all separating at a common point or close together (4). . . . . **Bibiocephala.**

Second longitudinal vein simple, without branch. . . . 3

3. No cross-vein connecting the fourth and fifth veins, that is, the second basal cell incomplete (1). . . **Blepharocera.**

A cross-vein connecting the fourth and fifth veins, the second basal cell complete (3). . . . . **Philorus.**

TABLES OF SPECIES.

BLEPHAROCERA.

1. Eyes of female contiguous, of male separated by broad space; length not over six millimeters. . . . . **ostensackeni.**

Eyes of both sexes separated by a narrow space; length not less than seven millimeters. 2

2. Ungues slender and rather long. . . . . **tenuipes.**
   Ungues stout and shorter. . . . . **jordani.**

BIBIOCEPHALA.

1. Eyes contiguous; anterior branch of second vein running into vein near margin of wing; eyes bisected; front femora of male strongly curved. , ... **grandis.**
   Eyes separated by a narrow or broad space, in both males and females; fore femora of male straight. 2

2. Eyes in both sexes bisected. . . , ... 3
   Eyes of male bisected, of female not bisected; anterior branch of second vein running into the first very soon, making a triangle in which the anterior branch forms the shorter side. **doanei.**

3. Eyes of male separated widely; of female narrowly; anterior branch of second vein running into first vein very soon, forming a nearly equilateral triangle. . . . . **elegantula.**
   Eyes of both male and female separated narrowly; anterior branch of second vein running into first about one-third the distance from origin of second to tip of first vein. . **comstocki.**

PHILORUS.

Philorus is represented by but two known species in America, viz: *yosemite* and *ancilla*, and by one species in Europe, *bilobata* Loew; of the two American forms, *P. ancilla* has the eyes contiguous (in the female at least), while the eyes of *P. yosemite* are separated by a broad front (in the male at least).

PALTOSTOMA.

Paltostoma is known by a single described species from the West Indies, and another from Brazil; one or the other or possibly a third is known also from Central America. *P. schineri* will be recognized from the generic characters and the figure.

XI. Family ORPHNEPHILIDÆ.

Small, obscurely reddish yellow, bare flies of peculiar appearance. Head small, round; holoptic in both sexes; ocelli wanting; proboscis short; palpi longer than the antennæ, five-jointed, the first joint short, the second the thickest; antennæ situated near the oral margin, apparently consisting of a small first joint, an oval second joint and a terminal arista; the second joint and the arista are, however, complex, composed of ten or eleven segments, the last of which terminates in a bristle. Thorax strongly convex, robust, without transverse suture, somewhat impressed before the scutellum. Scutellum rather large, obtusely three cornered; metanotum arched. Abdomen narrower than the thorax, cylindrical, composed of seven segments; male genitalia thick, the basal piece swollen, bladder-like; ovipositor with broad, rounded lamellæ. Legs simple, comparatively short; coxæ not elongated; tibiæ without spurs; tarsi moderately long; the front pair about as long as the tibiæ, the penultimate joint short; claws small; empodia vestigial. Wings

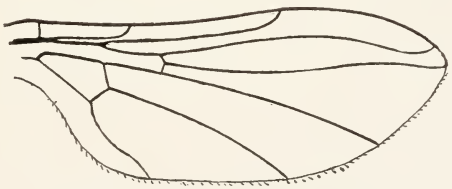


Fig. 48. Wing of *Orphnephila*.

longer than the abdomen; auxiliary vein short, terminating in the costa; second longitudinal vein sinuous;

third and fourth veins not furcate; anal angle rounded; basal cell short.

But three or four species of this singular family are known, and of them even, as far as I am aware, the larval habits are yet unknown. The known American species belong to one genus, *Orphnephila* Haliday; a second genus has been proposed by Mik. The small fly is found on the banks of streams.

XII. Family RHYPHIDÆ.

Head nearly hemispherical; eyes rounded, holoptic or dichoptic in the male; broadly separated by the front in the female; ocelli present. Antennæ about as long as the thorax, composed of sixteen joints, cylindrical, the two basal joints distinctly differentiated; those of the flagellum closely united, short-haired, gradually decreasing in size toward the end. Proboscis moderately prominent, with small labella; palpi long, four-jointed; the second joint longer and broader than the others. Thorax convex, without transverse suture; scutellum semicircular, short and broad; metanotum strongly developed. Abdomen flattened cylindrical, composed of seven segments; genitalia concealed or nearly so. Legs slender, without spines; the coxæ, especially the front pair, more or less elongated; metatarsi elongated; tibiæ with or without spurs; empodia pad-like, the pulvilli absent. Wings large, in rest lying flat upon the abdomen; auxiliary vein present; second and third veins not furcate;

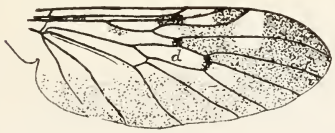


Fig. 49. *Rhyphus.*

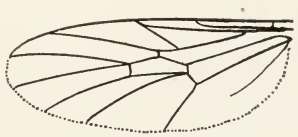


Fig. 50. *Olbiogaster.*

discal cell complete (fig. 49*d*); five posterior cells and two complete basal cells present; anal cell not narrowed in the margin.

But very few species of this family are known, belonging to but three genera. The typical genus *Rhyphus* con-

tains a number of species of wide distribution. The genus *Olbiogaster* is known from two or three species hitherto recorded only from Mexico and the West Indies. 'It differs from *Rhyphus* in the structure of the head (eyes separated by a broad front in both sexes, and occiput but very little developed), of the antennæ (scapus short, flagellum of male filiform, etc.), of the thorax and abdomen, as also in the venation.' (Osten Sacken.)

The larvæ of *Rhyphus* are worm-like, legless, naked, more or less transparent, with snake-like movements; there are two, short, fleshy points at the posterior end. The pupæ are free, inactive, with two projections anteriorly; they live in water of brooks, pools or puddles, or in rotting wood, hollow trees, or manure.

XIII. Family LEPTIDÆ.

Fig. 51. *Leptis mystacea*, enlarged. After Washburn.

Species of moderate or large size, more or less elongated, usually thinly pilose or nearly bare, without distinct bristles. Males holoptic or dichoptic. Empodium developed pulvilliform*, the pulvilli present (figure 14). Squamæ small or rudimentary. Antennæ very variable: (1) the flagellar joints distinct, as many as thirty in number (20); (2) the segments not more than eight in number, more closely applied, without style or arista (13); (3) fewer in number, with a differentiated, seg-

* *Hilarimorpha*, (1, 2), which is included in this family by most writers, has vestigial empodia and no discal cell. The tibial spurs, also, are very small.

mented style or arista, altogether not more than eight (19); (4) the third joint simple, with or without a terminal or dorsal arista (7, 9). Veins of the wings distinct, not crowded anteriorly; third longitudinal vein furcate; basal cells large; five posterior cells usually present.

As defined above, this family includes the Xylophagidæ, Leptidæ and Coenomyidæ of authors. It may be a question whether this union is justifiable, but, on the whole, it seems that the sole character which can be used to distinguish the families—the structure of the third antennal joint—divides the group unnaturally, throwing with the Xylophagidæ forms whose affinities are greatest with the Leptidæ, notwithstanding the antennal character.

The Xylophaginæ include less than one hundred known forms, and many of them are remarkable for their general resemblance to certain hymenopterous insects. Species of *Rhachicerus* form a connecting link with the Nemocera, and are apt to be confounded with the Rhyphidæ, but the presence of the pulvilli will distinguish them.

The larvæ are found in decaying wood or under the bark of trees and are carnivorous and predaceous, feeding upon the larvæ of beetles and other wood insects. The skin is parchment-like, the body cylindrical. The mouth-parts and antennæ are very small, the maxillæ short and hook-like. The first or the first three segments back of the head are chitinized above; the last segment above with a chitinized plate terminating posteriorly in two hooks. The fourth to the ninth segments have bristly pseudopods below. The pupæ are free. Larvæ of *Xylomyia* have been observed under the bark of fallen cottonwood trees.

The Leptinæ comprise something over two hundred known species. They are usually of moderate size and

not very active in their habits. The larger species are commonly found in meadows and woodlands, resting upon stems or trunks of trees with their head downward.

Fig. 52. *Cœnomyia ferruginea*, female; enlarged.

They are sometimes predaceous upon other insects, and the species of *Symphoromyia* have a habit of sucking blood as do the horseflies. The larvæ are predaceous, living in the earth, in decaying wood or in passages made by woodboring beetles. Others live in moss, in sand or in water. In general they are cylindrical, with or without fleshy abdominal legs. The last segment has a transverse cleft, the portion above which is provided with two, often backward-bent points or processes; the under part is obtuse, with the two stigmata between them.

The eggs of *Atherix* are deposited in dense masses attached to dry branches overhanging water. Not only do numerous females contribute to the formation of these masses, but they remain there themselves and die. The larvæ hatching, escape into the water. The flies of species of *Vermileo* deposit their eggs in sand, and the larvæ form conical pitfalls in which to ensnare small insects. The tenth segment of these larvæ bears above at its tip a transverse row of long hooklets directed backward, but with the hooks bent forward; the eleventh segment has a similar row directed forward, the hooks of which are

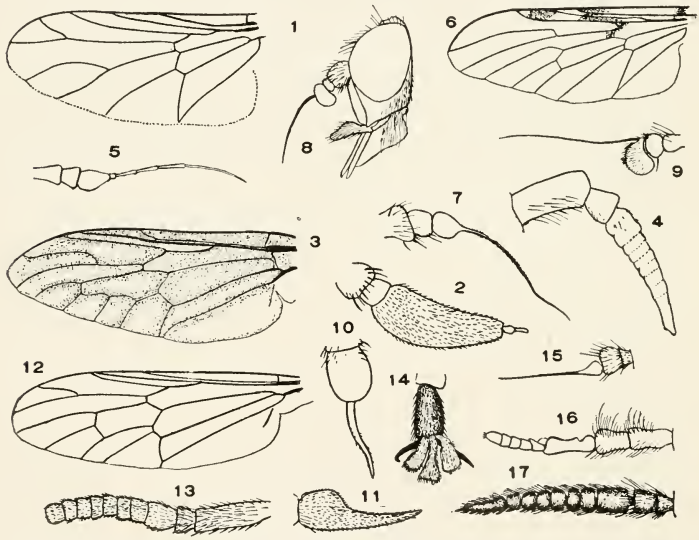


Fig. 53. Leptidæ. 1, *Hilarimorpha*, wing; 2, *Hilarimorpha*, antenna; 3, *Coenomyia*, wing; 4, *Coenomyia*, antenna; 5, *Pheneus*, antenna; 6, *Chrysopila*, wing; 7, *Chrysopila*, antenna; 8, *Symphoromyia*, head; 9, *Atherix*, antenna; 10, *Ptiolina*, antenna (Becker); 11, *Spania*, antenna (Becker); 12, *Xylophagus*, wing; 13, *Xylophagus*, antenna; 14, *Dialysis*, tarsus; 15, *Dialysis*, antenna; 16, *Glutops* (type) antenna (Burgess); 17, *Xylomyia*, antenna.

turned backward. On the fifth segment below there is a simple unpaired grasping foot which is capable of being protruded forward and downward; at its tip there are two triangular, sharp, flat, chitinous hooks, and below them some stiff bristles. The hooklets serve as aids in boring in the sand and to fix themselves; the organ on the fifth segment assists the larva in seizing and holding its prey, and also in constructing the pitfalls.

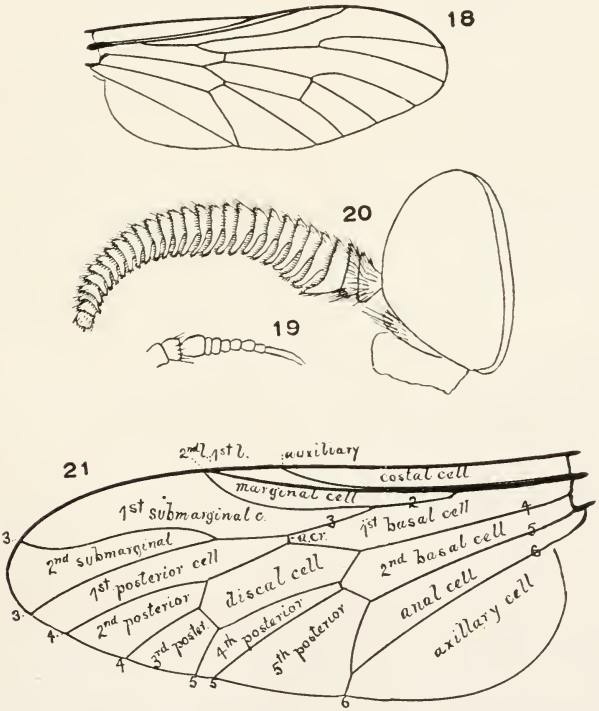


Fig. 54. Leptidæ. 18, *Arthroceras* (type), wing; 19, *Arthroceras* (type), antenna; 20, *Rhachicerus*, head; 21, *Atherix*, venation.

TABLE OF GENERA.

1. Flagellum of antennæ composed of numerous, more or less distinct divisions; the antennæ more or less elongated; five posterior cells present in all cases. 2

   Antennæ short, or but little elongated, the third joint simple, with a terminal or dorsal arista or terminal style; face small, usually excavated; proboscis short; some or all the tibiæ spurred (*Leptinæ*). 8

2. All the tibiæ with spurs (*Xylophaginæ*). 3

   Front tibiæ without spurs (*Arthroceratinæ*). . . . 6

XYLOPHAGINÆ.

3. All four posterior veins (i. e. the veins separating the posterior cells) arise from the discal cell; head small, scutellum with two spinous protuberances (*Cœnomyinæ*) (fig. 52, **3, 4**). **Cœnomyia.**

   The last posterior vein arises from the second basal cell, the fifth posterior cell hence not at all contiguous with the discal cell; scutellum without spines. 4

4. Flagellum of antennæ acute at tip, eight-jointed; tibial spurs 1:2:2. **Arthropeas.**

   Flagellum of antennæ not acute at tip. 5

5. Fourth posterior cell closed; flagellum of antennæ much elongated, composed of numerous (twenty–thirty) distinct divisions, often pectinate; eyes emarginate near the antennæ (**20**) (*Rhachicerinæ*. . . . . **Rhachicerus.**

   Fourth posterior cell open; flagellum composed of eight segments, less distinctly separated and never pectinate (**12, 13**). **Xylophagus.**

ARTHROCERATINÆ.

6. Fourth posterior cell open, , ... 7

   Fourth posterior cell closed (**17**, and **7, 8** *Stratiomyidæ*). **Xylomyia.**

7. Face projecting on each side in a rounded, subconical protuberance, thickly covered with hair (**16**). . . . , **Glutops.**

   Face with two, deep, diverging furrows, running from base of antennæ to oral margin (**18, 19**), . . . **Arthroceras.**

LEPTINÆ.

8. Front tibiæ without terminal spurs. 10
Front tibiæ with a single terminal spur; hind tibiæ with two. 9
Front tibiæ with two terminal spurs; hind tibiæ with two.
Triptotricha.

9. Antennal style slender and jointed; fourth posterior cell closed (**5**).
Pheneus.
Terminal arista not jointed; fourth posterior cell sometimes wanting (**14, 15**). . . . . **Dialysis.**

10. Discal cell wanting; four posterior cells only (**1, 2**).
Hilarimorpha.
Discal cell present; five posterior cells. 11

11. Third joint of the antennæ round, oval or pointed. . . 13
Third joint of the antennæ kidney-shaped, with a dorsal or subdorsal arista. 12

12. Hind tibiæ with a single spur; anal cell open; first antennal joint elongate and thickened (**8**). . . . **Symphoromyia.**
Hind tibiæ with two spurs; anal cell closed; first antennal joint not elongate and thickened (**9, 21**). . . . **Atherix.**

13. Hind tibiæ with two spurs; anal cell open (fig. 51). **Leptis.**
Hind tibiæ with a single spur; anal cell closed. . . . 14

14. Third antennal joint onion-shaped or conical, with a slender, arcuate, terminal bristle (**6, 7**). . . . . **Chrysopila.**
Third antennal joint elongate; not with a slender terminal bristle. 15

15. Third antennal joint with a short terminal style (**10**). **Ptiolina.**
Third antennal joint emarginate above, pointed, without style (**11**).
Spania.

Bolbomyia. 'More or less related to *Rupellia*, and may be placed among the Xylophagidæ, its somewhat aberrant venation notwithstanding. Characteristic is the shape of the antennæ; the third joint consists of four or five divisions, the first of which is much larger and swollen'. Loew. *B. nana*, District of Columbia. Length about three millimeters. This species has not been recognized since its description, nor the genus. Possibly it belongs to the Therevidæ.

XIV. Family STRATIOMYIDÆ.

Small to moderately large, nearly bare or thinly pilose, bristleless species. Head short, hemispherical or flattened, as broad as the thorax. Ocelli present. Eyes contiguous or separated by the front in the male. Antennæ porrect, approximated at the base, three-jointed, the third joint always complex, usually with a terminal style or an arista. Proboscis never elongated; palpi two-jointed, sometimes rudimentary. Thorax never strongly convex; scutellum often with tubercles, spines or projections on its margin, perhaps more exaggerated here than among any other group of flies (see fig. 65, **36**). Abdomen composed of from five to seven segments, usually flattened, often elongated. Legs never thickly pilose; without bristles, the tibiæ without spurs*; pulvilli and empodia pad-like. The costal vein does not reach beyond tip of the wing; veins often crowded anteriorly, and those posteriorly weak; discal cell present; four or five posterior cells, and one or two submarginal cells present, the anterior branch of the third vein short and often indistinct or wanting.

The family Stratiomyidæ is one of considerable size, including about a thousand known species. The flies are invariably flower insects, seldom with any marked powers of flight and never having the habit of hovering in the air. Not a few species are caught in the beating net or on the windows of dwelling houses. Many of the

* *Xylomyia* (**7, 8**) which Osten Sacken and Austen insist belongs in this family, has spurs on the middle and hind tibiæ and the costal vein encompasses the wing.

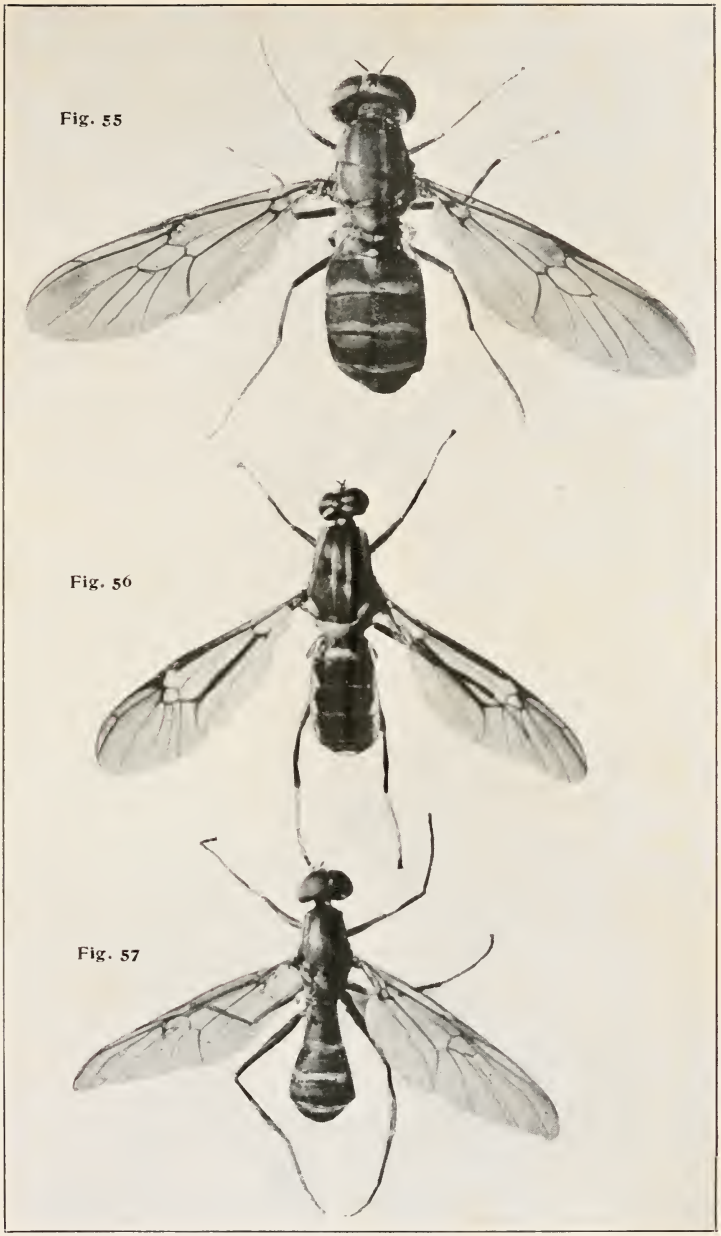


Fig. 55. *Chrysochlora.* Fig. 56. *Rhaphiocera.*
Fig. 57. *Ptecticus.*

species have in life bright yellow or green markings. The eggs, such as have been observed, are laid on the ground, on plants about water, or perhaps on the surface of the water itself. The larvæ are carnivorous, or feed upon decaying vegetable material. The larvæ of *Myiochrysa* have been found in cow-dung, and under stones; those of *Geosargus* in the flowing sap of elm trees; those of *Hermetia* in privies; those of *Pachygaster* and *Zabrachia* in decaying wood; those of *Beris* in moss; those of *Stratiomyia*, *Odontomyia*, *Nemotelus*, etc., in water. The larvæ of *Stratiomyia* have been observed in salt and alkaline water.

Fig. 58. *Cyphomyia;* female, enlarged.

The body is smooth and flattened, the last segment often prolonged into an elongated breathing tube and having a terminal transverse cleft. The pupæ are inactive, developing within the larval skin, the pupal skin remaining within, or partially within, the larval skin when the fly escapes through a longitudinal or transverse rent.

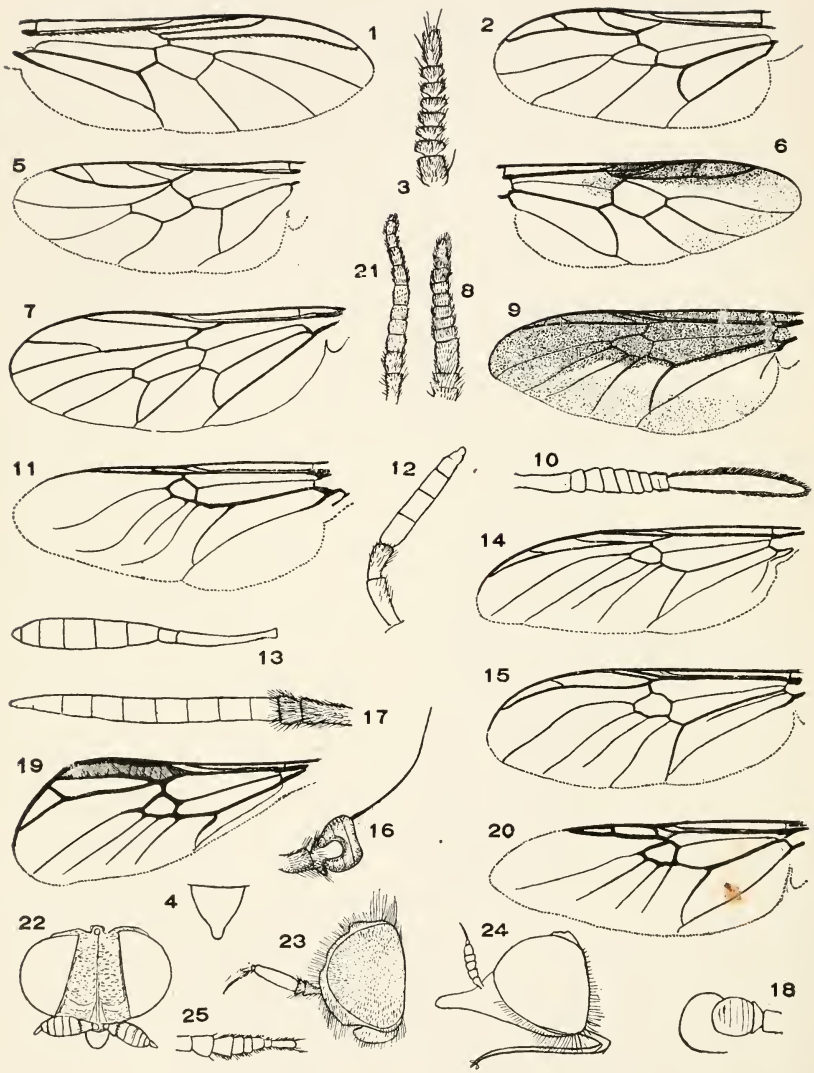
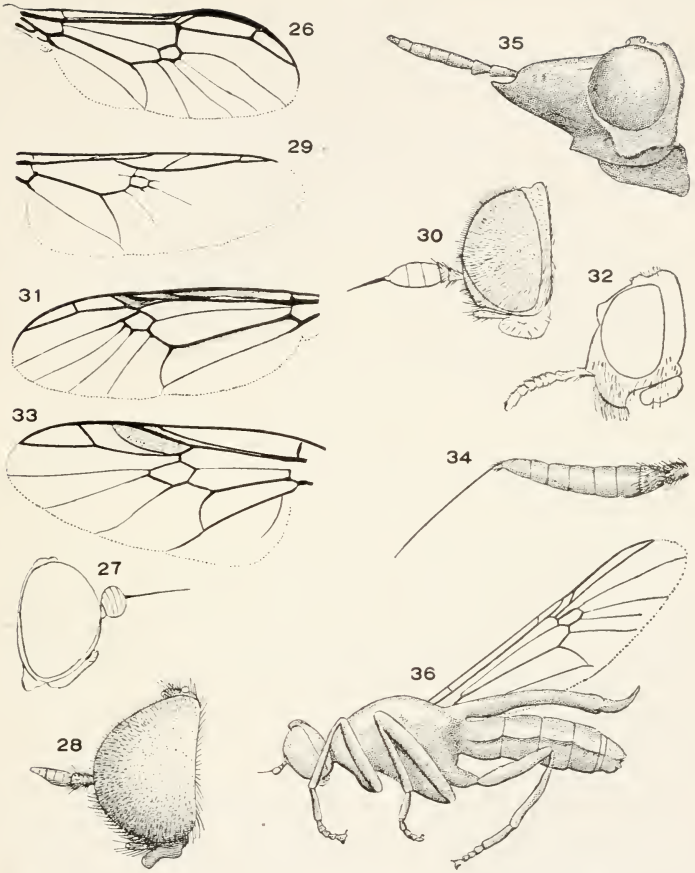


Fig. 59. Stratiomyidæ. (See next page.)



Figs. 59, 60. Stratiomyidæ. 1, *Chiromyza*, wing; 2, *Beris*, wing; 3, *Beris*, antennæ; 4, *Cynipimorpha*, scutellum; 5, *Cynipimorpha*, wing; 6, *Acanthina*, wing; 7, *Xylomyia*, wing; 8, *Xylomyia*, antenna; 9, *Hermetia*, wing; 10, *Hermetia*, antenna; 11, *Odontomyia*, wing; 12, *Odontomyia*, antenna; 13, *Stratiomyia*, antenna; 14, *Geosargus*, wing; 15, *Plecticus*, wing: 16, *Plecticus*, antenna; 17, *Cyphomyia*, antenna; 18, *Merosargus*, antenna; 19, *Histiodroma*, wing; 20, *Euparhyphus*, wing; 21, *Euparhyphus*, antenna; 22, *Euryneura*, head from in front; 23, *Pelagomyia*, head; 24, *Nemotelus*, head; 25 *Aochletus*, antenna; 26, *Analcocerus*, wing; 27, *Pachygaster*, head; 28, *Scoliopelta* (type), head; 29 *Microchrysa*, wing; 30, *Clitellaria*, head; 31, *Rhaphiocera*, wing; 32, *Myxosargus*, head; 33, *Allognosta*, wing; 34, *Chrysochlora*, antenna; 35, *Rhingiopsis*, head; 36, *Dicranophora*.

TABLE OF GENERA.

1. Abdomen with seven visible segments.. 5
   Abdomen with five or six visible segments. 2

2. Three posterior veins, all arising from the discal cell. . . 38
   Four posterior veins, the first and third sometimes vestigial but at least represented by angulations of the discal cell. . 3

3. All the posterior veins arise from the discal cell, the fifth posterior cell hence contiguous proximally with the discal cell. . 29
   The last posterior vein arises from the second basal cell. . 4

4. Antennæ with an elongate terminal or dorsal arista. . . 11
   Third antennal joint not with a distinctly differentiated arista, its segments homologous or nearly so. 20

BERIDINÆ.

5. Three posterior veins, all arising from the discal cell.* . 6
   Four posterior veins, or vestiges of them, all arising from the discal cell; scutellum with spines. 10

6. Scutellum with spines. 8
   Scutellum without spines. 7

7. Short, small species; third vein with an anterior branch (33). **Allognosta.**
   More elongate and larger species, especially in the female; third vein simple (1). . . . . **Chiromyza.**

8. Scutellum with ten spines. . . . . **Heteracantha.**
   Scutellum with less than ten spines. 9

9. Head hemispherical (2, 3). . . . . **Beris.**
   Head not hemispherical; the antennæ situated low down, the frontal region long and plane. . . . . **Berismyia.**

10. Hind femora thickened. . . . . **Neoexaireta.**
    Hind tibiæ thickened at extremity.† . . . . **Actina.**

* The third vein rarely arises from the basal cell in species of *Beris*.

† The genus *Actina*, to which *Beris viridis* has been referred, has a dichoptic head in the male, four posterior veins arising from the discal cell, thickened distal extremity of the tibiæ, etc. Osten Sacken has given as the chief distinction of the genus from *Beris* the well-developed palpi, vestigial in *Beris*. In our species of *Beris*, however, the palpi are of considerable size. *Beris viridis* differs from other species of the genus in having dichoptic eyes in the male; but its venation is typically that of *Beris*.

SARGINÆ.

11. Scutellum with spines. 12
Scutellum without spines. 14

12. Third vein with anterior branch (fig. 54; **31**). **Rhaphiocera.**
Third vein without anterior branch. 13

13. Scutellum produced into a stout median process, bearing two divaricate spines at its tip (**36**). *Dicranophora*, S. A.
Scutellum with marginal spines. . . . **Nothomyia.**

14. Second longitudinal vein coalescent with the first in a broad expansion of the costa; antennæ moderately long, the long arista flattened (**19**). . . . . **Histiodroma.**
Wings not with an anterior distal expansion of the costa. . 15

15. Anterior ocellus more widely separated than the other two; males holoptic or dichoptic. 16
Ocelli equidistant, more approximate. 17

16. Abdomen contracted at its base, clavate or pedicillate **Macrosargus***.
Abdomen not clavate or pedicillate (**14**) (*Sargus*). **Geosargus.**

17. Second antennal joint prolonged on the inner side, closely overlying the third joint (fig. 56, **15, 16**) . . **Ptecticus.**
Second antennal joint not with such a projection. . . 18

18. Third joint of antennæ elongate, composed of four segments, with a long terminal arista thickened and pubescent at its base. **Acrochæta.**
Third antennal joint short, oval or subulate, with an apical or preapical arista. 19

19. Hind femora moderately thickened at base; non-metallic, more or less yellow species (**18**). . . . . **Merosargus.**
Hind femora not more thickened at base; usually blue, green and metallic species, elongate. . . . **Chrysochroma.**
Hind femora slender; small, deep-colored species; the holoptic eyes of the male with an area of enlarged facets above; eyes hairy (*Myiochrysa*); or bare (**29**). . . . **Microchrysa.**

STRATIOMYINÆ.

20. Third vein with an anterior branch. 21
Third vein without anterior branch; scutellum spinose. . 28

* The genus *Macrosargus* is so feebly differentiated that I do not think it can be maintained. If not, the name must take preference over *Geosargus* Bezzi, substituted for *Sargus*, preoccupied.

21. Scutellum without spines; first two joints of antennæ short. **Chordonota.**
Scutellum with spines, rarely absent in species of *Odontomyia*. 22

22. Costa thickened distally in front; antennæ elongate, the flagellum composed of six closely united segments (**26**). **Analcocerus.**
Costa not thickened distally in front. 23

23. Third antennal joint composed of four, five or six closely united segments. 24
Third antennal joint composed of seven or eight closely united segments. 26

24. Head strongly produced forward for insertion of the antennæ, the face much retreating (*Promeranisa*, S. A.)
Head not strongly produced forward. 25

25. First antennal joint three or more times the length of the second (**13**). . . . . **Stratiomyia.**
First antennal joint less than three times the length of the second (**11, 12**). . . . . **Odontomyia.**

26. First antennal joint two or three times the length of the second, the third much elongated, ... 27
First antennal joint but little longer than the second, the third terminating in a bristle. . . . . **Neorondania.**

27. Thorax narrowed anteriorly; body with green and yellow markings. . . . . **Campeprosopa.**
Thorax not narrowed in front; body black, not with green and yellow markings; posterior orbits of female often conspicuously tumid and colored (fig. 58; **17**). . . . **Cyphomyia.**

28. Head strongly produced anteriorly, with a porrect spine immediately below the insertion of antennæ (*Rhingiopsis*, S. A. **35.**)
Head not projecting, the face produced conically downward; third joint of antennæ composed of six* segments (**32**). **Myxosargus.**

CLITELLARINÆ.

29. Scutellum with spines. 30
Scutellum without spines. 35

* The genus *Myxosargus* was described by Brauer as having eight segments in the third joint of the antennæ, the segments distinguishable with difficulty. The species referred by me to this genus have but six segments in the third joint, easily distinguishable. The posterior orbits of the female are thin and expanded, and the females of all the species have one or more conspicuous tubercles on the front.

30. Antennæ short, with a subterminal arista. . . **Oxycera.**
Antennæ more or less elongate. 31

31. Antennæ situated near the oral margin, third joint composed of five or six segments (**22**). . . . . **Euryneura.**
Antennæ situated near middle of head in profile. . . 32

32. Antennæ much elongated; style not differentiated; eyes bare; smaller species (**20, 21**). . . . . **Euparhyphus.**
Antennæ moderately elongated. 33

33. Style of antennæ not differentiated; eyes pubescent; occiput flattened (**28**). . . . . **Scoliopelta.**
Style of antennæ distinctly differentiated. 34

34. Eyes pubescent; antennæ with a slender style (**30**). **Clitellaria.**
Eyes bare; style not slender (**25**). . . . **Aochletus.**

35. Face produced conically. 36
Face not produced. 37

36. Males holoptic (**24**). . . . . **Nemotelus.**
Males dichoptic. . . . . **Alisonia.**

37. The third antennal joint terminates in a very long, densely fringed, lamelliform style; large, elongate species; eyes pubescent or bare (**9, 10**). . . . . **Hermetia.**
Third joint of antennæ with a short, thickset, differentiated style terminating in a short bristle; eyes pubescent; moderate sized species (**23**). . . . . **Pelagomyia.**
The third antennal joint tapers into a long, thickened, or styliform arista, the basal two-thirds of which is short but densely plumose, the distal extremity bristly; eyes bare (*Cacosis*, S. A.).
The third antennal joint terminates in a long slender arista, not at all pubescent or hairy at base; eyes bare, large species (fig. 55; **34**). . . . . **Chrysochlora**

PACHYGASTRINÆ.

38. Antennæ situated near or toward the oral margin; scutellum spinose; males holoptic; eyes pubescent. 39
Antennæ situated near the middle of the head in profile. . 43

39. Third joint of antennæ forked; scutellum quadrispinose. . 42
Third joint of antennæ not forked. 40

40. Third joint of antennæ elongate, with a short, differentiated style; scutellum quadrispinose (**6**). . . . . **Acanthina.**
Third joint of antennæ shorter; ending in a bristle. . . 41

41. Third joint antennæ oblong, with its apex attenuated, the arista bare; scutellum bispinose (*Spyridopa*, S. A.).
Third joint subglobose; scutellum bispinose (*Panacris*, S. A.)

42. Upper branch of antennæ with a terminal arista and a lateral process. . . . . **Neochauna.**
Upper branch with a short, slender style and no lateral process (*Blastocera*, S. A.).

43. The scutellum terminates in a stout median spine or process (4, 5) **Cynipimorpha.**
Scutellum without median spine or process, simple. . . 44

44. Third vein with an anterior branch. 45
Third vein without branch. , ... **Zabrachia.**

45. Third antennal joint oval, with its terminal arista briefly but densely plumose. . . . . **Lophoteles.**
Third joint rounded or oval, its terminal arista bare (27). **Pachygaster.**

The relationships of the genera allied to *Sargus* (*Geosargus*)—*Merosargus*, *Macrosargus* (*Pedicella* Bigot), *Chrysochroma*, *Microchrysa* and *Myiochrysa*, are all more or less doubtful. Even *Ptecticus* can not be sharply limited by the structure of the second antennal joint. I suspect that *Pedicella* will have to take precedence over *Sargus*; *Macrosargus* and *Geosargus*, and that *Chrysochroma* will have to be merged into *Merosargus*. The whole group sadly needs revision. The genus *Nothomyia*, which I do not know, may perhaps find its proper place under 28.

XV. Family ACANTHOMERIDÆ.

Fig. 61. *Acanthomera* sp., ♀, Venezuela; natural size.

Very large, stout, bristleless, nearly bare flies. Eyes large, contiguous in the male. Ocelli present. Third joint of the antennæ complex, composed of seven segments, with a terminal, often in the male setiform style. Proboscis short, not adapted for piercing, with fleshy labella; palpi two-jointed. Squamæ rudimentary. Tibiæ without spurs; pulvilli and empodia pad-like. Wings with two submarginal and five posterior cells, the fourth posterior cell and the anal cell closed.

But two genera are known in this family, including altogether only about fifteen or sixteen species, all of which are inhabitants of Central and South America. The species of *Acanthomera* are found in forests, alighting on trunks of trees, according to Mr. Champion; otherwise their habits, whether of the adult or immature stages, are but little known. Brauer has figured and described the larvæ of *A. frauenfeldii*. They are cylindrical, thick and short. The last segment is firmly chitinized above

with two series of hooklets, the two projecting backward in the middle being stout and curved; below these there is a deep, transverse cleft, on the under side of which is a rounded lip.

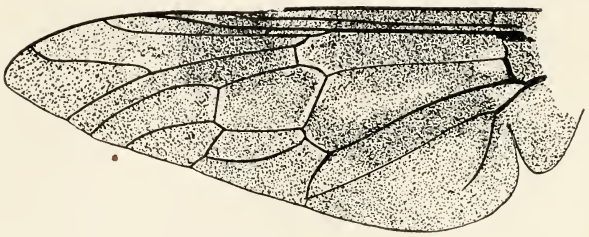


Fig. 62. *Acanthomera*, sp. wing.

In both *Acanthomera* and *Rhaphiorhynchus* the face may be produced conically or not at all. The two genera are distinguished by the structure of the second joint of the palpi, in *Acanthomera* slender, in *Rhaphiorhynchus* stout and pointed. Both genera may have a spine on the under side of the hind femora.

Osten Sacken has already commented upon the supposed distinctions between *Acanthomera* and *Rhaphiorhynchus*, making it clear that only the palpal character is of service, and even that is doubtful since it may be only sexual. I have examined five or six species of the family and am very skeptical of the validity of *Rhaphiorhynchus*.

There are apparently no valid nor just reasons for the retention of the generic name *Acanthomera*. Wiedemann more than once, arbitrarily and without giving reasons, rejected the earlier names of genera and species for ones of his own creation, and the present seems to be one of the most flagrant examples. The description and figure

of *Pantophthalmus tabaninus* Thunberg leave no doubt of the form to which they apply, and the description was published two years earlier than that of *Acanthomera*, and was quoted by Wiedemann. Possibly Wiedemann thought the name inappropriate, but, to say the least, it is no more inappropriate than his *Acanthomera*, in which the 'spiny femora' may be only an individual character, certainly not generic.

The relationships of the family are very close indeed to the Stratiomyidæ, and the families might, very properly, be united.

XVI. Family TABANIDÆ.

BY PROF. J. S. HINE.

Fig. 63. *Tabanus lineola*; enlarged. After Lugger.

Head large, the occiput flattened or concave. Antennæ porrect, the third joint composed of from four to eight segments or annuli. Eyes large, pubescent or bare, contiguous above in the male, and often with some of the facets much larger than the others; in the living insect of either sex usually with green or purple bands or spots. Ocelli present or absent. Proboscis projecting, sometimes as long as or longer than the body; palpi two-jointed, that is with one movably articulated joint, which is variable in length and thickness in different genera. Thorax and abdomen clothed with fine hairs, never with bristles. Abdomen broad, never constricted at the base, composed of seven visible segments; genitalia never prominent. Legs moderately stout, the tibiæ sometimes much dilated; middle tibiæ always with two spurs at tip; empodium developed pulvilliform, the pulvilli always present. Wings but little variable; two submar-

ginal and five posterior cells always present; basal cells large, anal cell usually closed, but never far before the border of the wing; the marginal vein encompasses the entire wing. Squamæ of considerable size. Flies of moderate or large size, never slender; rarely with brilliant colors.

Fig. 64. *Pangonia guttata;* enlarged.

This family includes the insects commonly called horseflies, green-headed flies, etc., and has a wide distribution over the world. About eighteen hundred species have received names, of which not less than two hundred and seventy-five are from North America. None of the species are active on dark, cloudy days, though some are partial to shady woods, and are very annoying to stock in such places. On clear, warm days, horseflies begin flying as soon as the sun has warmed the air, and are

usually most active toward the latter part of the forenoon, although they are plentiful about cattle and horses during most of the time while the sun is shining. The females only are bloodsucking in habit; the males feed upon the juices of plants, the honey-dew secreted by plant-lice and scale insects, and similar substances. The females also will feed as the males do, when nothing more to their liking is procurable. Their bites are painful, but are not usually attended with that inflammation or swelling characteristic of the mosquitoes and punkies.

Most species of Tabanidæ may be collected in various situations. Sweeping the grasses and weeds of marshy places, collecting from fences and trunks of trees in the early morning, or from plants much infested by plant-lice or certain scale insects throughout the day, netting specimens that fly about stock or the collector's own head, or that may be found upon various flowers, or capturing such as may enter the doors and alight upon the windows, all are productive of results. Collections made in these ways are pretty sure to represent well the tabanid fauna of any locality.

The eggs of the Tabanidæ are deposited in large masses on the stems and leaves of plants or in similar places over water or in marshy land. They are spindle-shaped, brown or black in color, and, in ordinary summer temperature, hatch in from seven to nine days The larvæ feed upon various small creatures, and in such cases as have been observed reach maturity and change to pupæ the following spring. The pupal stage is completed in three or four weeks, the whole cycle from the deposition of the eggs to imaginal maturity thus requiring about eleven months for its completion. The larvæ may be sought for in rotting logs and stumps, in the soil in the vicinity of ponds, under stones about ditches, or swim-

ming free in the water; indeed one may occasionally find them in the most unexpected places. The pupæ are difficult to find in nature, though they usually rest near the surface of the ground wherever the larvæ come to maturity. Larvæ taken in the spring are easily reared in jars of moist earth on a diet of angle worms; but only a single specimen can be reared in each jar, for they are cannibalistic in nature. The body of the larvæ is eleven-segmented, each segment usually encircled by a row of fleshy protuberances, which are most pronounced on the

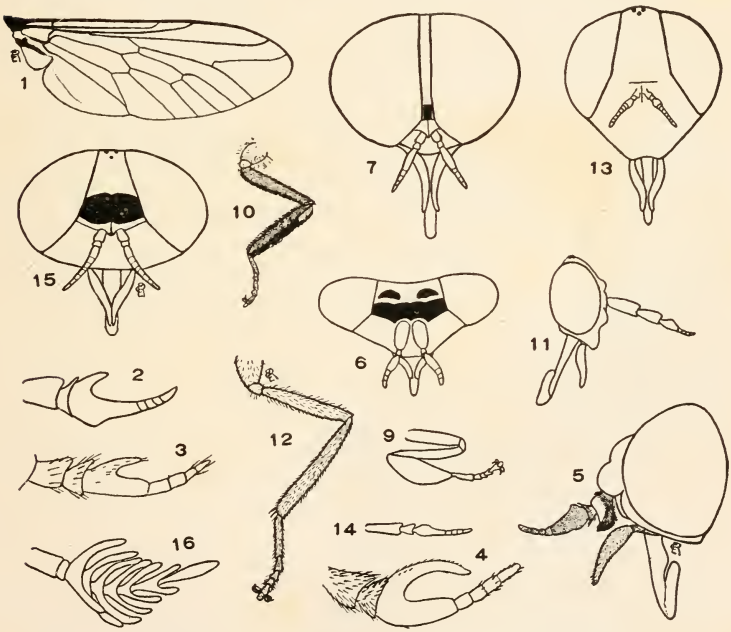


Fig. 65. Tabanidæ. 1, *Tabanus*, wing; 2, 3, *Tabanus*, antennæ, 4, *Dichelacera*, antenna; 5, *Snowiellus*, head, side; 6, *Hæmatopota* head, in front; 7, *Diachlorus*, head, front; 9, *Lepidoselaga*, front leg; 10, *Stibasoma*, leg; 11, *Chrysops*, head; 12, *Chrysops*, leg; 13, *Goniops*, head, front; 14, *Silvius*, antenna; 15, *Apatolestes*, head, front; 16, *Pityocera*, antenna (Giglio-Tos). Figures by J. S. Hine.

ventral side, where they serve as prolegs. The head is small, but distinct, and the mouth-parts are peculiar; the mandibles are two strongly chitinized pieces which work antero-posteriorly; when they are retracted the anterior ends point directly forward, but when protruded, they point downward and backward, thus forming a pair of hooks by which the prey is held.

TABLE OF GENERA.

1. Hind tibiæ with spurs at tip. 2
   Hind tibiæ without spurs at tip. 8

2. First six segments of the third joint of antennæ each produced into a pair of long processes (16). . . . **Pityocera.**
   None of the segments of third joint of antennæ produced into lateral processes. 3

3. Third joint of antennæ composed of five segments, the first of which is much longer than the following ones; ocelli present. 4
   Third joint of antennæ composed of eight segments, the first of which is only slightly longer than the following ones. . 5

4. Second joint of antennæ only half as long as the first (14). **Silvius.**
   Second joint of antennæ distinctly more than half as long as the first (11, 12). . . . . **Chrysops.**

5. Fourth posterior cell of wing closed (*Dielisa*). . . **Scione.**
   Fourth posterior cell open. 6

6. Eyes of female acutely angulated above; wings in both sexes dark on anterior part, hyaline behind (13). . . **Goniops.**
   Eyes of female not acutely angulated above; wings nearly uniform in color or hyaline. 7

7. Front of female wide; much wider below than above; proboscis only a little longer than the palpi (15). . **Apatolestes.**
   Front of female of normal width or narrow; its sides usually parallel; ocelli present or absent; proboscis often long or very long. **Pangonia.**

8. Third joint of antennæ composed of four segments; front of female very wide (6). . . . . **Hamatopota.**
   Third joint of antennæ composed of five rings or segments; front of female not unusually wide. 9

9. Third joint of antennæ with a distinct basal angle or process above. 11
Third joint of antennæ not with a process or distinct angle above. 10

10. Front of female narrow; front tibiæ rather broad (7). **Diachlorus.**
Front of female of normal width; front and middle tibiæ greatly dilated (9). . . . . **Lepidoselaga.**

11. Hind tibiæ ciliate with long hairs. 12
Hind tibiæ not ciliated. 13

12. Third antennal joint with a very long basal process, the annulate portion short; front tibiæ dilated (10). . . **Stibasoma.**
Third antennal joint with a basal prominence; antennæ situated on a projecting prominence (5). . . . **Snowiellus.**

13. Basal process of third antennal joint unusually long, at least reaching the third ring of the joint; body long (4) **Dichelacera.**
Basal process of third joint often short or obsolete, at most not reaching the end of the first segment (2, 3). . **Tabanus.**

A. Eyes pubescent; an ocelligerous tubercle present in the male. **Therioplectes.**
B. Eyes bare; no ocelligerous tubercle. . . **Tabanus.**
C. Eyes pubescent; no ocelligerous tubercle. . **Atylotus.**

XVII. Family CYRTIDÆ.

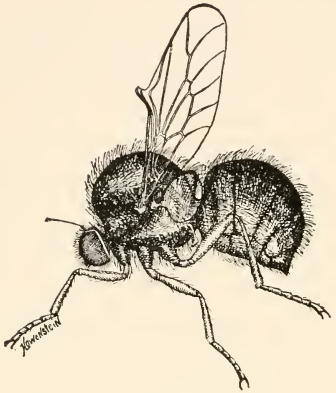


Fig. 66. *Opsebius pterodontinus*, enlarged. After Lugger.

Small to large, never elongate, pilose or nearly bare flies. Head small or very small, formed chiefly by the large eyes, which are usually contiguous in both sexes above or below, or above and below the antennæ; three, two or no ocelli present; antennæ composed of two or three joints, with or without a terminal arista or bristle. Proboscis rudimentary or long, sometimes very long. Thorax large, spherical; squamæ very large and inflated; scutellum large. Abdomen closely united to the thorax, large and inflated. Legs rather stout; the tarsi with three membranous pads under the claws. Venation variable, the veins sometimes weak and indistinct; often a supernumerary cross-vein between the third and fourth veins.

This family, the Cyrtidæ or Acroceridæ, comprises a small number of curious flies with curious habits. They

are easily recognizable by their small head and large, inflated squamæ. No family characters can be drawn from the venation, owing to the great differences often exist-

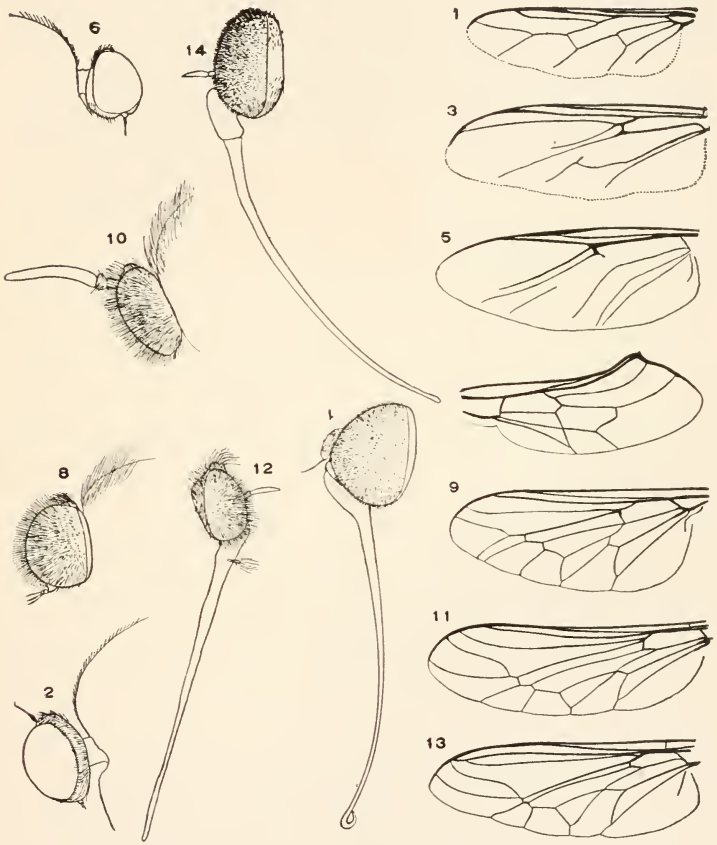


Fig. 67. Cyrtidæ. 1, *Acrocera*, wing; 2, *Acrocera*, head; 3, *Philopota*, wing. 4, *Philopota*, head; 5, *Oncodes*, wing; 6, *Oncodes*, head; 7 (number removed by engraver), *Pterodontia*, wing; 8, *Pterodontia*, head; 9, *Ocnæa*, wing; 10, *Ocnæa*, head; 11, *Eulonchus*, wing; 12, *Eulonchus*, head; 13, *Lasia*, wing; 14, *Lasia*, head.

ing between forms otherwise related. In the few forms in which the larvæ are known they are parasitic upon spiders or their cocoons. 'In the spring of 1887, while hunting for spiders, I found hanging in cobwebs several soft white maggots and pupæ. The webs were generally old and out of repair, and a closer examination showed that no living spider was in them, but almost every one had an empty skin of a common spider *Amaurobius sylvestris*, nearly full grown. The skin of the legs and thorax was not clean like a moulted skin, but dirty and opaque, as though eaten out, and the skin of the abdomen when present was torn and shriveled. From this I concluded that the maggots came out of the spiders, and from their size must have nearly filled them. The maggots varied considerably in size, the largest being a quarter of an inch long, while others were not more than half as large. The hinder half of the body was thicker than the front half and nearly spherical. They hung head downward, holding to the web by their jaws and were also partly supported by threads under and around them.' The author of the foregoing, J. H. Emerton, reared from other specimens of these larvæ a fly belonging to the genus *Acrocera*. The larvæ of *Astomella lindelii*, according to Brauer, are so lodged in the abdomen of the spider that the posterior terminal stigmata are in relation with the lung-tubes of the spider. The eggs are said to be deposited on dried twigs.

TABLE OF GENERA.

1. Antennæ without terminal arista or style. 2
   Antennæ with a terminal arista. 3

2. Antennæ short, third joint rounded, with terminal bristly hairs. 3
   Antennæ elongate. 7

3. Antennæ inserted below the middle of the head in profile. . 4
   Antennæ inserted above the middle of the head. . . . 6

4. Wings with a stout costal spur near the tip of first vein (**7, 8**) **Pterodontia.**
   Wings without such spur. 5

5. Proboscis small or vestigial* (**5, 6**). . . . **Oncodes.**
   Proboscis elongate, directed backward; prothoracic lobes broadly united above (**3, 4**). . . . . **Philopota.**

6. Venation complete; eyes pilose (fig. 66). . . **Opsebius.**
   Venation more or less obsolete; eyes bare (**1, 2**). . **Acrocera.**

7. Proboscis very small, vestigial. 8
   Proboscis elongate. 10

8. Eyes bare. . . . . **Appeleia.**
   Eyes pilose or pubescent. 9

9. Third joint of antennæ with terminal bristly hairs. **Pialeoidea.**
   Third antennal joint not with terminal bristly hairs (**9, 10**). **Ocnæa.**

10. Ocelli wanting; large flies (**13, 14**). . . . . **Lasia.**
    Ocelli present; moderately large flies (**11, 12**). . **Eulonchus.**

* Compare *Nothra americana* Bigot. The occurrence of this genus in North America is doubtful. If, however, Bigot correctly recognized it, the species should be sought for under *Oncodes*.

XVIII. Family NEMISTRINIDÆ.

Species of moderate size, not elongate, thinly or densely pilose. Venation complicated; the fourth and fifth veins are curved forward to terminate before the tip of the wing; the anterior cross-vein is obsolete, that is the third and fourth veins coalesce for a short distance; basal cells long. Antennæ small, short; third joint simple, with a terminal, slender, jointed style. Proboscis sometimes elongate. Ovipositor of the female elongate, often slender. Tibiæ without spurs; empodia developed pulvilliform, but, with the pulvilli often minute. (See fig. 69.)

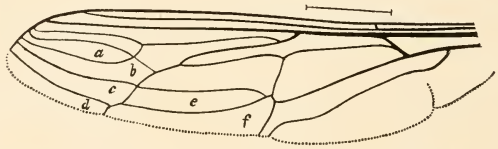


Fig. 68. Wing of *Rhynchocephalus volaticus*.
a, third submarginal cell; *b*--*f*, first—fifth posterior cells.

Throughout the world about one hundred species of this family are known, the larger part of which are from South America and Australia. Only six species are known from North America and two or three from all Europe. Some of the species have the wings with numerous cross-veins, almost recticulate in appearance. *Megistorhynchus longirostris* from Africa, though only about two-thirds of an inch in length, has a proboscis nearly three inches long. The adults are flower flies, resembling in their habits the Bombyliidæ.

But little is known of the larvæ. The females of *Hirmoneura obscura* have been observed laying their eggs deeply within the burrows of *Anthaxia*, a wood-boring

insect, in the pine rails of fences. The eggs were found in clusters and the young larvæ hatched from them differed very singularly from those of a more mature growth. They were more slender, but differed chiefly in having each of the abdominal segments from the sixth to the twelfth provided with a pair of false legs bearing a single elongate seta at the tip, the hooks pointing backward; on the thirteenth segment there were two pairs of similar setæ, the hooks of which, however, pointed forwards, thus enabling the larva to attach itself firmly and raise itself erect. These young larvæ issued in great numbers from the burrows in which they were hatched and, placing themselves erect, were blown away by the wind. Here for a time they have not been followed, but it is probable that they attach themselves by the aid of the ventral hooks to the bodies of large-sized beetles, by which they are carried into the ground when the females enter to deposit their eggs. This is probable from the fact that hundreds of pupæ and pupa skins were observed near the fence. On searching below these the larval skins were found at a depth of about two inches, and still deeper were found the remains of the beetles, *Rhizotrogus solstitialis*, in some instances with the larvæ yet within them. Females of *Rhynchocephalus sackeni* have been observed by Bruner apparently depositing eggs in the stems of *Eriogonum alatum*.

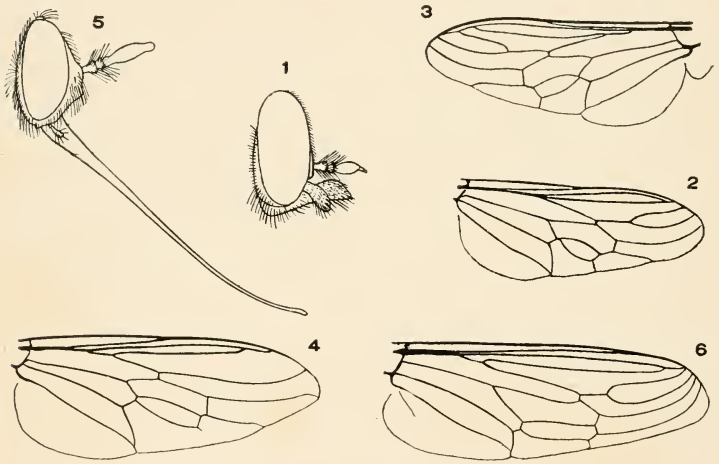
TABLE OF GENERA.

1. Proboscis short, protruding but little from the oral opening; eyes bare or pilose; two or three submarginal cells. **Hirmoneura.**

Proboscis long; antennæ broadly separated; eyes bare; ovipositor composed of two slender lamellæ; three submarginal cells present (fig. 68). . . . . **Rhynchocephalus.**

XIX. Family APIOCERIDÆ.

Rather large, elongate, chætophorous, thinly pilose flies. Antennæ three-jointed, with or without a small, short style. Front not excavated, broader in the female. Ocelli present. Face short. Proboscis not adapted for piercing, the labella not horny. Third longitudinal vein of wings usually furcate; basal cells large; five posterior cells present. Empodia wanting. Male forceps enlarged.



Fig; 71. Apioceridæ. *Apiocera haruspex*, head; 2, *Apiocera haruspex*, wing; 3, *Apiocera*, sp. (Australia) wing; 4, *Apiocera* (gen. nov. Australia) wing; 5, *Rhaphiomidas acton*, head; 6, *Rhaphiomidas acton*, wing.

Less than a score of species of this family are known throughout the world, seven of which have been described from North America. The genera have been variously placed among the Mydaidæ, Asilidæ and

Fig. 69. *Trichophthalma*, species (Nemestrinidæ); enlarged.

Fig. 70. *Apiocera*, species; enlarged. (Australia.)

Therevidæ, but seem best isolated into a distinct group, though the relationships of *Rhaphiomidas* with the Mydaidæ are evident; perhaps as close as with *Apiocera*. The members of the genus *Apiocera* have much the appearance of large Therevidæ or of Asilidæ, from which they will be at once distinguished by the anterior curvature of the third and fourth veins of the wings. The larvæ are unknown. See fig. 70.

TABLE OF GENERA.

1. Palpi two-jointed, large; the second vein from the discal cell terminates beyond the tip of the wing (**1, 2**). . **Apiocera.**
   Palpi one-jointed, small; the second vein from the discal cell terminates before the tip of the wing; proboscis elongate (*Apomidas*) (**5, 6**). . . . . **Rhaphiomidas.**

XX. Family MYDAIDÆ.

Rather large to very large (see fig. 1, page 16), thinly clothed or bare, elongated flies. Venation complicated, the basal cells long, the fourth vein always terminating at or before the tip of the wing; posterior branch of fourth sometimes present and terminating also before the tip of the wing, as in *Rhaphiomidas* (Apioceridæ), but not present in American species. Antennæ composed of four joints, the fourth always, the third usually elongate. Front excavated between the eyes; both sexes dichoptic; ocelli wanting. Proboscis with fleshy labella, and without palpi (in our species). Empodia very little developed, not pulvilliform.

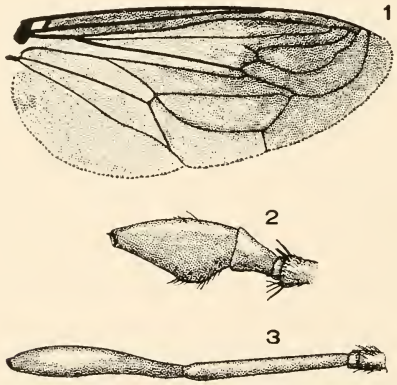


Fig. 72. Mydaidæ. 1, *Dolichogaster*, wing; 2, *Dolichogaster*, antenna; 3, *Mydas*, antenna.

The family Mydaidæ comprises only about a hundred known species, more abundantly represented in Australia, Africa, South and Central America. The family

comprises the largest of known diptera. The relationships of the family are very close with *Rhaphiomidas* of the Apioceridæ, through the Tricloninæ.

The larvæ of species of *Mydas* live in decaying wood, and it is probable that other members of the family have similar habits. They are known to be predaceous in some cases upon the larvæ of beetles. The larvæ of *M. fulvipes* are nearly two inches in length, with swellings below the abdominal segments for locomotion; the body is depressed and somewhat widened, with the posterior extremity broader and somewhat obtuse. The pupa of *M. clavatus* has at its anterior end two strong, sharp, outwardly curved hooks; the first abdominal segment has at its anterior border above, a row of very long, erect spines, curved backward at the tip. Another series of spines is situated on the anterior border of the last segment; and, on the same segment there is a pair of hooks at the tip curved downward.

TABLE OF GENERA.

1. Terminal segment of the female abdomen with a circlet of spines. 3
   Terminal segment of female abdomen without circlet of spines. 2

2. Antennæ but little longer than the head, the third short and the fourth expanded; cross-vein between the second and fourth posterior cells present or not (1, 2). . **Dolichogaster.**
   Antennæ much longer than the head, the third and fourth joints elongated; the latter moderately or but slightly expanded (*Phylomidas*)*. (Fig. 1, and 3.) . . . . . **Mydas.**

3. Hind tibiæ of female with spur; a short vein ends in hind margin of the wing between the second and fourth posterior cells. **Ectyphus.**
   Hind tibiæ of female without terminal spur; no such cross-vein; proboscis elongate. . . . . **Leptomydas.**

* I have examined specimens of *Phylomidas phylocerus*, the type species of the genus, from Norton County, Kansas, in the University of Kansas Museum. The genus is not valid, differing from *Mydas* only in the more expanded fourth antennal joint.

XXI. Family ASILIDÆ.

Fig. 75. *Promachus vertebratus*, natural size. After Washburn.

Species of moderate to large size, rarely small; usually more or less elongate in form, sometimes thickly hairy; always bristly, the bristles sometimes conspicuously strong; highly predaceous in habit. Head flattened, broad and short, separated from the thorax by a freely movable neck. Front excavated between the eyes, dichoptic in both sexes, the front of the male not narrowed. Ocelli present, usually situated upon a rounded tubercle; front with bristles. Antennæ porrect, simple, usually composed of three simple joints, the third more or less elongate, and with or without a terminal style or arista, the bristle exceptionally pectinate; sometimes the so-called style is thickened, forming one or two antennal joints. Proboscis never markedly elongate; firm and horny, adapted for piercing, directed downward, or downward and forward; labella never fleshy; palpi composed of one or two joints. Abdomen composed of eight

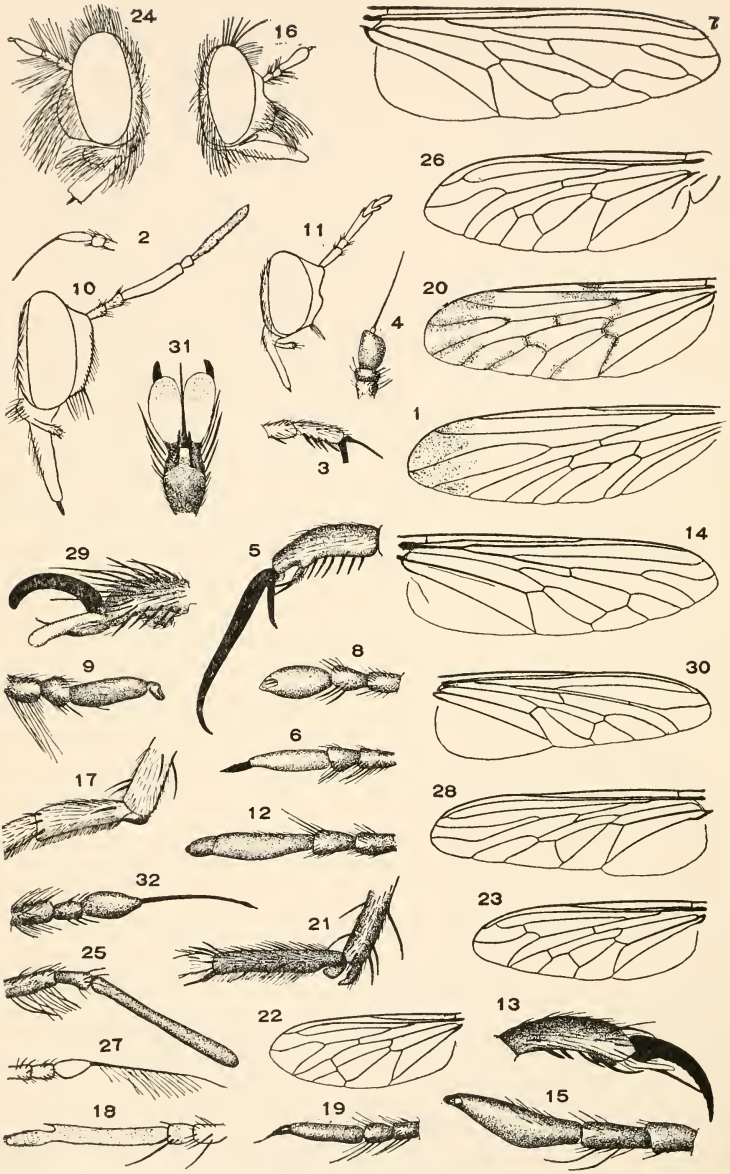
Fig. 73. *Craspedia coriaria* Life size.

Fig. 74. *Erax quadrimaculatus.* Three times natural size.

segments, the hypopygium and ovipositor usually prominent. Legs strong, bristly, of moderate length, rarely elongate and slender; tarsi strong; empodium bristle-like (31) or wanting, the pulvilli rarely vestigial. Squamæ small. Wings when at rest lying parallel over the abdomen; basal cells long; two or three submarginal and five posterior (four in *Townsendia* and *Leptopteromyia*, 35) cells present; first and fourth posterior and the anal cells closed or open. (Figs. 73 and 74.)

The family Asilidæ, or Robber-flies is one of the largest and best known among diptera, including about three thousand species, distributed in more than one hundred and fifty genera. Many of the species are conspicuous for their large size, the largest measuring nearly two inches in length, while the smallest known species is over four millimeters. They are, perhaps, the most predaceous of all flies in their habits. The greater part of them rest upon the ground in wait for their prey, arising with a quick buzzing sound when disturbed, to alight a short distance beyond. Some of the Laphrinæ have a striking resemblance to humble bees, and are usually observed resting upon foliage about the borders of forests. All their food, which consists wholly of other insects, is caught upon the wing; their luckless victims when once seized by their strong feet are powerless to escape. Their prey is usually other flies and hymenoptera, but flying beetles, especially the Cicindelæ, are often caught, and they are known to capture and destroy large dragonflies. In one instance that the writer observed, a female seized a pair of her own species, and thrusting her proboscis into the

Fig. 76. *Dasyllis*, species; natural size. After Kellogg.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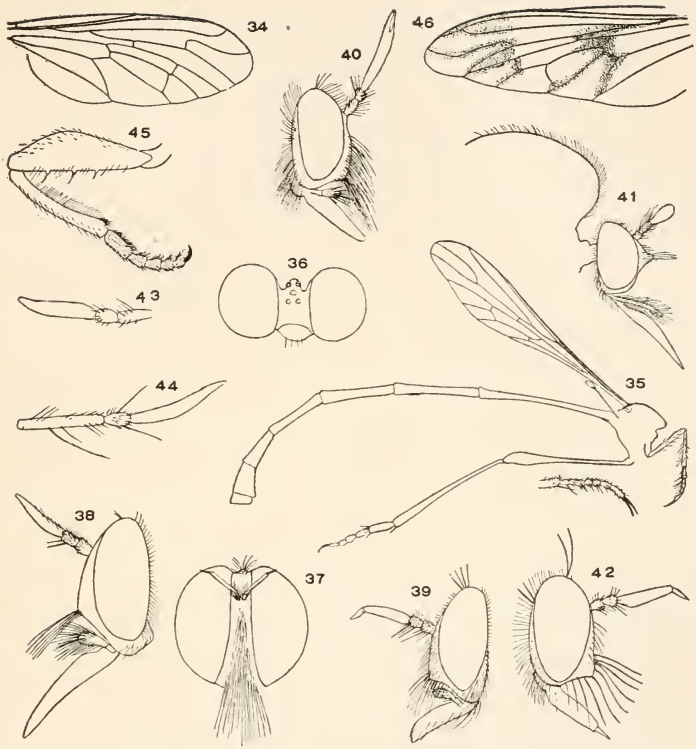

Fig. 76. Asilidæ. 1, *Leptogaster*, wing; 2, *Leptogaster*, antenna; 3, *Leptogaster*, end of tarsus (claw mostly cut away); 4, *Damalis occidentalis*, antenna; 5, *Dicranus jaliscoensis*, claw; 6, *Stenopogon* (*Scleropogon*) *truquii*, antenna; 7, *Microstylum galactodes*, wing; *Psilocurus*, sp. antenna; 9, *Laphystia*, species, antenna; 10, *Ceraturgus cruciatus*, head; 11, *Myelaphus melas*, head; 12, *Dioctria nitida*, antenna; 13, *Blepharepium coarctatum*, claw; 14, *Deromyia winthemi*, wing; 15, *Deromyia*, antenna; 16, *Lestomyia fraudigera*, head; 17, *Taracticus*, tibial spur; 18, *Taracticus*, antenna; 19. *Cophura*, antenna; 20, *Nicocles rufus*, wing; 21, *Pseudorus*, tibial spur; 22, *Atomosia puella*, wing; 23. *Pogonosoma dorsata*, wing; 24, *Dasylechia* (*Hyperechia*) *atrox*, head; 25, *Dasyllis*, antenna; 26, *Laphria*, wing; 27, *Ommatius tibialis*, antenna; 28, *Eccritosia* (*Proctacanthus*) *amphinome*, wing; 29, *Mallophora*, claw; 30, *Promachus*, wing; 31, *Promachus*, claws; 32, *Promachus*, antenna.

Fig. 77. Asilidæ. 34, *Psilocurus caudatus*, wing; 35, *Leptopteromyia gracilis* (type, Brazil); 36, *Holcocephala nitida*, head, from in

thorax of the male, carried them both off together. The larvæ live for the most part in rotting wood, under bark, or in soil containing decomposing vegetable matter, under leaves, etc., and feed upon grubs and other larvæ. The larvæ are cylindrical in shape, with parchment-like skin, the abdominal segments sometimes girdled with rounded tubercles, or with abdominal protuberances for locomotion, The pupæ are free, with strong hooklets at the anterior end, the abdomen provided with spiny girdles, mixed with hairs below and behind; the last segment has two short, divaricate hooklets and several smaller projections.

The young larvæ sometimes bore their way completely within the bodies of other larvæ, remaining there till their food is wholly consumed. Often the larvæ are found free in the earth, however, where their transformations occur. The eggs are laid about grass stems, or in crevices of decaying logs and trees infested by the larvæ of other insects.

The division of the family into four subfamilies based upon the closure or non-closure of the marginal cell, and the presence or absence of a terminal bristly arista is artificial in a large measure, but at the same time is very useful. I also doubt the importance of the terminal spur on the front tibiæ as a true index of relationships. So far as my studies go, the structure of the palpi is a more natural character for subfamily division, the Dasypogoninæ and Laphrinæ having two joints, the Leptogastrinæ and Asilinæ one. The Leptogastrinæ are, furthermore, entitled to subfamily distinction because of the

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front; 37, *Stenopogon* (*Scleropogon*) *truquii*, head; 58, *Archilestris magnificus*, head; 39, *Chrysoceria pictitarsis*, head; 40, *Dizonias*, sp. head; 41, *Pseudorus bicolor*, head; 42, *Atonia mikii*, head; 43, *Atomosia macquartii*, antenna; 44, *Cerotainia*, species, antenna; 45, *Lampria*, species, hind leg; 46, *Laphria* (*Nusa*), sp., wing.

remarkably attenuated body and the more generalized venation. The dividing line between the Dasypogoninæ and Laphrinæ will be more difficult to make, since there are forms with closed marginal cell whose natural relationships are closer with the Dasypogoninæ, and vice versa. It is probable that the following characters will be found the most natural, for the ordinary grouping at least:

A. Palpi one-jointed; antennæ with a slender terminal arista.
  B. Marginal cell open; very slender species. **Leptogastrinæ.**
  BB. Marginal cell closed, less slender or robust species. **Asilinæ.**
AA. Palpi two-jointed; antennæ with or without a thickened terminal style; very rarely with a terminal arista,
  C. Marginal cell open, or rarely closed at extreme tip. **Dasypogoninæ.**
  CC. Marginal cell closed. . . . . **Laphrinæ.**

TABLE OF GENERA.

1. Marginal cell of wings open (**14**). . . . **Dasypogoninæ.**
   Marginal cell closed (**22, 23,** etc.) 2

2. Antennæ with a terminal bristle (**32**). . . . **Asilinæ.**
   Antennæ with or without a terminal style (**24, 25**). **Laphrinæ.**

DASYPOGONINÆ.

Marginal cell of wings open; antennæ with or without a terminal style or bristle.

1. Front tibiæ with a terminal, claw-like spur (**17**). . . 32
   Front tibiæ not with a terminal claw-like spur. . . . 2

2. Pulvilli vestigial or wanting, ... 3
   Pulvilli normal (the hind pair rarely shortened). . . . 5

3. Third joint of antennæ with an arista or aristiform style; abdomen very slender; hind femora much elongated and clubbed at extremity (Leptogastrinæ) (**1, 2, 3**). . . **Leptogaster.**
   Antennæ not with a terminal arista. 4

4. Claws very long, with an elongated tooth at the base of each claw; large species (**5**). . . . . **Dicranus.**
   Claws normal; smaller species. . . . . **Ablautus.**

5. Antennæ with a slender, terminal arista (4). . . **Damalis.**
Antennæ with or without a terminal style, the latter sometimes simulating antennal joints. 6

6. Only four posterior cells present; front very broad above; small species. . . . . **Townsendia.**
Five posterior cells as usual. 7

7. Head narrow, about as high as broad; face narrow above, broader and swollen below, in large part covered with hair; large, elongate species. 7
Head very obviously broader than high. 10

8. Antennæ with a terminal style. 9
Third joint of antennæ long, without visible style; fourth posterior cell closed before the border of the wing; black species, with or without red on the abdomen. . . **Ospriocerus.**

9. Style more than a fourth the length of the third antennal joint; a row of trichostical bristles usually present; first posterior cell usually closed (*Scleropogon*) (6, 37). . **Stenopogon.**
Style about one-sixth the length of the third joint; trichostical bristles usually absent. . . . . **Stenopogon.**

10. Fourth posterior cell closed in or before the margin of the wing. 11
Fourth posterior cell wide open, rarely nearly closed. . 16

11. Antennæ much elongated, apparently composed of five joints. 17
Antennæ less elongated; style of antennæ small or vestigial, not simulating antennal joints. 13

12. Face bare except on oral margin; large or very large species. 12
Face hairy or bristly. 14

13. Vein posterior to the second posterior cell continuous or nearly so with the fourth vein beyond the discal cell, the last section of the fourth vein oblique, closing or much narrowing the first posterior cell (7). . . . . **Microstylum.**
Last section of fourth vein continuous in nearly the same direction with the penultimate section, the first posterior cell not closed or narrowed (38). . . . . **Archilestris.**

14. Abdomen cylindrical*, not narrowed at tip, elongate ; near the proximal margin of the second and third segments with a white

* Compare here *Sphageus;* I do not know the genus and can not locate it more precisely from the description.

pollinose, emarginate cross-band; wings dark; males very different in coloration from the females (40). . . **Dizonias.**

Abdomen less elongate, with five or six white-pollinose entire or interrupted cross-bands.* 15

15. Style of antennæ vestigial; veins at outer side of the discal and fourth posterior cells parallel or nearly so (8, 34). **Psilocurus.**

Style distinct, though small; veins at outer side of discal and fourth posterior cells not at all parallel; marginal cell narrowly closed or open; first posterior cell open, closed or narrowed; face gently or not at all convex, more or less clothed with hair. (*Triclis*†) (9). . . . . **Laphystia.**

16. Antennæ elongate, composed of five joints; nearly bare species of considerable size. 17

Antennæ less elongate or rather short, the third joint with or without a short or slender style; no spine on upper side of third joint. 19

17. First joint of antennæ about three times the length of the second, third elongate, fourth and fifth of nearly equal length; third and fourth at their tip with two lobes or processes reaching to about the middle of the following joint (11). **Myelaphus.**

Third and fourth antennal joints not lobed at tip. . . 18

18. First and second joints of antennæ of nearly equal length, the third elongate, fourth short, fifth elongate and densely pubescent (10). . . . . **Ceraturgus.**

First four joints of antennæ as in preceding, the fifth oval, with a short lateral spine. . . . . **Ceraturgopsis.**

19. Style of antennæ short, thick, obtuse, not easily distinguishable from the third joint, or, if so, forming apparent antennal joints; antennæ more or less elongate. 20

Terminal style of the antennæ more slender than the third joint, divergent or easily distinguishable; antennæ usually shorter. 22

20. Nearly bare species; face flattened, bare, save below. Small or rather small species, for the most part shining or metallic black, with narrow or cylindrical abdomen and large wings. . 21

* If thorax and abdomen yellow and black, without pollinose cross-bands, the wings conspicuously orange-colored and blackish, *Cacodæmon* (*Prolepsis*) S. A.

† The so-called species of *Triclis* and *Laphystia* are very variable, and I doubt their generic distinction, notwithstanding the open or closed first posterior cell.

More pilose species, the bristles few and hair-like; antennæ springing from a convexity, the facial profile thence receding to the tubercle, which is situated low down; abdomen short, head rather narrow. . . . . **Dicolonus.**

21. All the tibiæ and the hind femora with short, strong setæ. **Echthodopa.**
Hind femora, at least, without such setæ (12). . **Dioctria.**

22. Abdomen slender; front broad anteriorly, very narrow behind, the ocelli far forward. . . . . **Plesioma.**
Front not narrowed behind. 23

23. Face distinctly swollen in profile, gibbous. . . . 24
Face flattened, or gently convex. 25

24. Rather or quite thickly pilose; the gibbosity of the face reaches to the base of the antennæ; anal cell usually open. **Cyrtopogon.**
Thinly pilose, more pollinose species; the convexity of the face is confined to the lower part; anal cell usually closed. **Lasiopogon.**

25. Hind tibiæ distally and the hind metatarsi much thickened. 26
Hind tibiæ not or but slightly thickened distally; hind metatarsi not enlarged. 27

26. Head much broader than high, transverse, goggle-like in appearance; abdomen short; wings large (compare *Metapogon*) (36). **Holcocephala.**
Head only moderately broader than high, not at all spectacle-like in appearance. . . . . **Holopogon.**

27. Abdomen with thick, recumbent pile above; thickly pilose species; antennæ slender. . . . . **Pycnopogon.**
Abdomen not with such pile above. 28

28. Slender, nearly bare species; face perpendicular, straight or gently concave in profile, narrowed above, and bare, except on oral margin. 29
Face gently rounded, not prominent below, in large part hairy, and but slightly or not narrowed above. . . . 30

29. Thickly whitish pollinose; abdomen flattened, usually reflected upward; third joint of antennæ and the style both slender. **Stichopogon.**
Less thickly pollinose; abdomen cylindrical, a little broader at the base; third joint of antennæ short and broad, the style minute. **"Habropogon".**

30. Large, elongate species, the style of antennæ short. **Callinicus.**
Moderately large, not markedly elongate species. . , 31

31. Abdomen broader at base, depressed; thorax often strongly convex above, antennæ slender, the style long and slender (compare also species of *Cyrtopogon* and *Metapogon*).
Heteropogon.
Abdomen short, cylindrical; black, with bright golden, opaque pollinose markings on thorax and abdomen (**39**).
Chrysoceria.

32. Face bare, with bristles on oral margin, in profile straight or gently concave, the oral margin most prominent. . . . 33
Face convex below, the oral margin not the most prominent, more or less covered with hair. 35

33. Fourth posterior cell closed a considerable distance before the margin of the wing; antennæ without style. . . . 34
Fourth posterior cell open or closed in the margin. **Saropogon.**

34. Posterior pulvilli much shorter than the elongated claws; abdomen contracted toward the base (**13**)*. . . **Blepharepium.**
Posterior pulvilli not much shorter than the claws; abdomen not contracted toward the base† (**14, 15**). . . **Deromyia.**

35. Third joint of the antennæ more or less dilated, the style very short (**16**). . . . . **Lestomyia.**
Third joint of antennæ slender, elongate. 36

36. Head broad and flat, the face not gibbous. 37
Face convex, densely covered with hair; thickly hairy species.
Lastaurus.

37. Third joint of the antennæ with an excision on the upper border before the tip, bearing a small spine; abdomen punctulate (**17, 18**) (*Dioctrodes* Coq.) . . . . . **Taracticus.**‡
Third antennal joint with a small terminal style; abdomen smooth, not punctulate. 38

38. Abdomen flattened, in the male a little broader beyond the middle; in the male near the tip, the last two segments conspicuously silvery above (**20**). . . . . **Nicocles.**
Abdomen of male not flattened and silvery distally (**19**).
Cophura.

* If abdomen not contracted toward the base, the scutellum with bristles, *Allopogon*, S. Amer.

† If abdomen contracted toward the base, the scutellum without bristles *Senobasis* (*Lochites*), S. Amer.

‡ *T. vitripennis* and *T. niger*, with a large two-jointed style, and without lateral spine, must be separated generically.

LAPHRINÆ.

Marginal cell closed, antennæ with or without a terminal style, not with a terminal bristle.

1. Front tibiæ with a terminal, claw-like spur. 2
   Front tibiæ not with such spur. 3

2. Thorax projecting prominently in front (21, 41). **Pseudorus.**
   Thorax not projecting prominently in front.* . **Doryclus.**

3. Veins at distal ends of the discal and fourth posterior cells parallel or continuous in the same straight line. . . . 4
   Veins at distal ends of discal and fourth posterior cells very distinctly angulated and not parallel. 7

4. Third joint of antennæ with a terminal style, in length greater than the first two together; eyes not or but slightly emarginated on the sides of the front, the front much wider above; scutellum without bristles, or with hairs; small species (42). **Atonia.**
   Third antennal joint without terminal style. . . . 5

5. Third joint of antennæ at least three times as long as the first two together; rather large species. . . . . **Aphestia.**
   Third antennal joint not more than twice the length of the first two combined; small species. 6

6. First antennal joint more than twice the length of the second; front much widened above, the eyes disciform and with enlarged facets in front; scutellum with weak bristles; body punctulate (44). . . . . **Cerotainia.**
   Third joint of antennæ not more than twice the length of the second; eyes on the sides of the front emarginate, the front not widened above; scutellum with bristles; first posterior cell usually narrowed; body punctulate (22, 43). . **Atomosia.**

7. Three submarginal cells present; first posterior cell closed or narrowed (23). . . . . **Pogonosoma.**
   Two submarginal cells. 8

8. Antennæ with a distinct terminal style. 9
   Antennæ not with a terminal style. 10

9. Rather small, nearly bare species, with pollinose spots or fasciæ on the abdomen; first posterior cell open or closed (see Dasypogoninæ, 16; *Laphystia*.)

* The distinction between these two genera seems doubtful to me. *Megapoda* is a distinct genus, characterized by the hind tibiæ and metatarsi not being thickened; the name is not preoccupied.

Very large, robust, thickly hairy species; first posterior cell narrow throughout; hind femora of nearly equal thickness throughout (*Hyperechia*) 24. . . . . Dasylechia.

10. Densely pilose, large species, the abdomen short and broad, usually broader beyond the middle (25). . . . Dasyllis.
More elongate, less hairy or nearly bare species, the abdomen not distinctly broader beyond the middle. 11

11. Body nearly bare; hind femora usually with spinous tubercles below; species of rather moderate size (45). . . Lampria.
Body more or less hairy, from rather small to large size; first posterior cell often narrowed or closed (*Nusa*); hind femora not with spinous tubercles below (26, 46). . . Laphria.

ASILINÆ.

Marginal cell closed; antennæ always with a long terminal arista. (32.)

1. Bristle of antennæ pectinate below (27). . . Ommatius.
Bristle of antennæ bare. 2

2. The veins closing the discal and fourth posterior cell in the same straight line or parallel. . . . . Atractia.
The veins closing the discal and fourth posterior cells not parallel. 3

3. The posterior branch of the third vein curves forward to meet the costa at or before the tip of the wing; or the anterior branch of the third vein angulated near its origin, with stump, or both. 4
The posterior branch of third vein terminates beyond the tip of the wing; the anterior branch without stump. 6

4. Ovipositor cylindrical, with a terminal circlet of spines. . 5
Ovipositor laterally compressed, without terminal circlet of spines (fig. 74). . . . . Erax.

5. Abdomen shorter than the wings (28). . . . Eccritosia.
Abdomen longer than the wings (28). . . Proctacanthus.

6. Two submarginal cells. . . . . Asilus.*
Three submarginal cells. 7

7. Abdomen shorter than the wings; body thickly pilose; claws obtuse (29). . . . . Mallophora.
Abdomen longer than the wings; body thinly pilose; claws more pointed (30, 31, 32). . . . . Promachus.

* In general the subdivisions of the old genus *Asilus* are very vague

SUBGENERA OF ASILUS.

a. Ovipositor laterally compressed. . . . . b
Ovipositor conical. . . . . h

b. Third antennal joint unusually hairy*. . **Anarmostus.**
Third antennal joint not unusually hairy. c

c. Face without gibbosity, narrow throughout, not at all carinate, the mystax composed of a few long hairs. **Senoprosopis.**
Face with gibbosity, or not unusually narrow. . . . d

d. Posterior border of the last ventral segment in the male more or less widened. . . . . **Machimus.**
Posterior border of the last ventral segment of the male not unusually widened. . . . . e

e. Legs prevailing shining yellow in color. **Heligmoneura.**
Legs prevailingly black, or light and opaque colored. . f

f. Abdomen shining black above and below. **Stilpnogaster.**
Abdomen not shining black above and below. . . . g

g. Male genitalia club-like. . . . . **Neoitamus.**
Male genitalia not club-like; the sixth and seventh segments take no part in the formation of the female ovipositor. **Tolmerus.**

h. Abdominal segments with bristles before the incisures. **Philonicus.**†
Abdominal segments not with bristles before the incisures, i

i. Bright-colored, larger species. . . . . **Asilus.**
Small, ashy gray species. . . . . **Rhadiurgus.**

and hard to define, and many of them are doubtfully entitled to recognition. At the most, few if any of them are based upon real generic characters, and the names are only useful as aids in the determination of the numerous forms.

The groups *Epitriptus*, *Lophonotus* and *Neoëristicus* have also been reported from Central America by Bellardi and Bigot, but there is doubt as to their correct reference.

* The only reported species of *Anarmostus* is from Brazil and British Honduras. It has the abdomen deep steel blue and black, the wings deep steel blue (16 mm.)

† Loew. Linn. Ent. 144; *Philodicus* Loew, Dipt. f. S. Afr. p. 144.

XXII. Family THEREVIDÆ.

Fig. 79. *Thereva senex*, enlarged. After Lugger.

Rather small or moderate sized, elongate (American forms), bristly, sometimes pilose, predaceous flies. Eyes of the male contiguous or approximated; front in the female not excavated. Antennæ composed of three joints, the third simple, with a terminal style, sometimes wanting. Proboscis projecting, the labella broad; palpi two-jointed. Ocelli present. Abdomen elongate, genitalia moderately or but little prominent. Legs with bristles; empodia wanting; pulvilli rarely wanting. Third longitudinal vein of the wings furcate, the posterior branch terminating beyond the tip of the wing; five posterior cells, anal cell usually closed toward the margin of the wing.

The family comprises about two hundred known species, with but few widely distributed genera. The flies resemble the Asilidæ somewhat, and have habits not dissimilar, though much less active. The proboscis has fleshy labella, instead of the horny tip of the Asilidæ, and the legs are less stout—in many species they are easily broken off when captured. Their food is chiefly other diptera, for which they lie in wait upon leaves and bushes, or upon the bare ground. The larvæ have a short, eyeless, nonretractile head, the antennæ small and short. The body is slender and snake-like, showing apparently nineteen segments. Anterior spiracles situated at the end of the first segment behind the head; posterior spiracles on the apparently seventeenth segment. The larvæ live in the earth and decomposing wood, or in sand, feeding upon other insects or upon vegetable matter, ordure, etc. The pupæ are free; they have in front laterally projecting spinous points.

The genera of this family are, for the most part, very unsatisfactorily founded. Few structural differences exist, save in the antennæ and proboscis, and these differences seem usually to have specific value only. Five genera have been proposed for North American species; each contains a single species, and in all probability there never will be any additions to them. On the other hand *Thereva* and *Psilocephala*, with numerous species, are doubtfully distinguished by the vestiture of the face! If the smaller genera are recognized, at least one or two more should be formed for those species of *Thereva* having a thickened first antennal joint (*T. melanopheba* Loew, *T. crassicornis* Bell., *T. pachyceras*, n.n. for *T. crassicornis* Will.) The closure or non-closure of the fourth posterior cell occurs in both genera and complicates matters. The division of the first posterior cell in

Metaphragma is, I believe, purely a specific character, and will not be found in allied species.

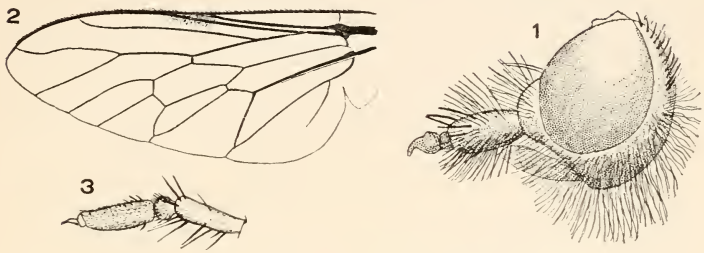


Fig. 80. Therevidæ. 1, *Tabuda*, head; 2, *Psilocephala*, wing: 3, *Psilocephala*, antenna.

TABLE OF GENERA.

1. First antennal joint much thickened and elongate. . . . 2
   First antennal joint not noticeably thickened. 5

2. Head not as broad as long; vertical diameter of the eyes equaling the horizontal diameter; eyes of male dichoptic. **Nebritus.**
   Head distinctly broader than long. 3

3. Third antennal joint about one-third the length of the first; fourth posterior cell open. 4
   Third antennal joint more or less elongated. . **Thereva**, pt.

4. First posterior cell divided by a cross-vein. . **Metaphragma.**
   First posterior cell not divided by a cross-vein (*? Pachyrhiza*, *? Baryphora*) (1). . . . . **Tabuda.**

5. Third joint of the antennæ about four times the length of the first; without style; fourth posterior cell closed; front of male broadly dichoptic. . . . . **Henicomyia.**
   Third joint of antennæ not four times the length of the first; fourth posterior cell open or closed. 6

6. Face bare; usually more bare and shining species (2, 3) (*Ozodiceromyia*). . . . . **Psilocephala.**
   Face distinctly pubescent or hairy; usually more pilose and pollinose species. (Fig. 80; also fig. 15, p. 42, not *Rhyphus*.) **Thereva.**

XXIII. Family SCENOPINIDÆ.

Flies of moderate or small size; generally black in color and bare. Front not excavated; face bare, short and broad. Antennæ approximated at the base, the first two joints short, the third elongated, simple, without style or arista. Proboscis concealed; palpi cylindrical, bristly at the tip. Ocelli present. Males usually holoptic. Thorax rather long, moderately convex, though apparently much so from the low position of the head. Scutellum broad and short, without spines or tubercles. Abdomen flattened, or cylindrical, composed of seven segments. Squamæ small. Empodia wanting. Third longitudinal vein of the wing furcate; basal cells long, the first much longer than the second; three posterior cells, the first narrowed in, or closed before the margin; anal cell closed.

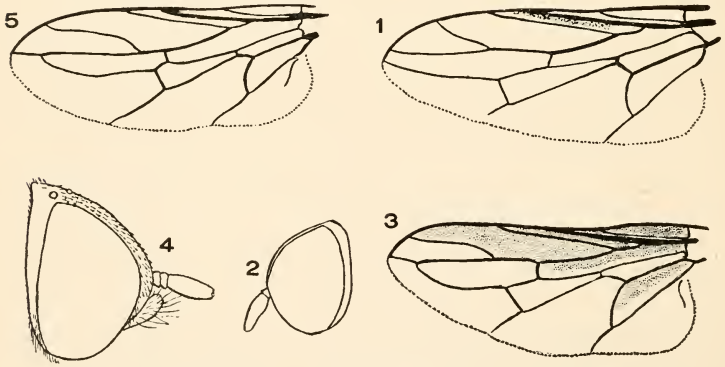


Fig. 81. Scenopinidæ. 1, *Scenopinus*, wing; 2, *Scenopinus*, head; 3, *Metatrichia*, wing; 4, *Metatrichia*, head; 5, *Pseudatrichia*, wing.

The larvæ resemble closely those of the Therevidæ. They are very long and slender, having apparently nine-

teen segments, due to each of the abdominal segments except the last being partially divided by a strong constriction. The larvæ have been found in decaying fungi and wood and under carpets or in furniture, and are supposed to be carnivorous. The flies are not very active in their habits, and because of the frequency with which some are observed on window-panes are usually called window-flies.

TABLE OF GENERA.

1. First posterior cell open (**1, 2**). . . . . **Scenopinus.**
   First posterior cell closed before the margin of the wing. . 2

2. Body short, clothed with scales (**3, 4**). . . **Metatrichia.**
   Body elongate, without scales (**5**). . . . **Pseudatrichia.**

XXIV. Family BOMBYLIIDÆ.

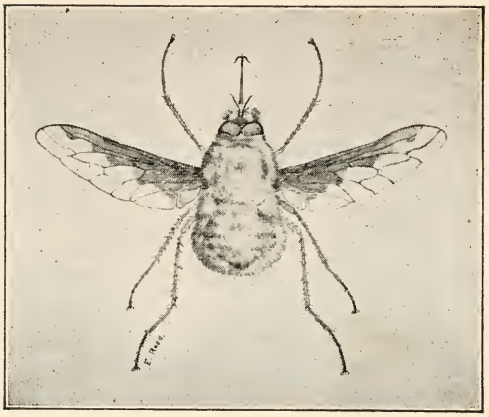


Fig. 84. *Bombylius major*, enlarged. After Washburn.

Rather large to small flies; often with abundant, long and delicate hair, rarely with conspicuous bristles. Head as broad as, or narrower than the thorax, often spherical in shape, closely applied to the thorax. Eyes large, often contiguous above in the male, and rarely also in the female. Antennæ porrect, usually of moderate length or quite small; third joint simple; style usually small and indistinct, never more than two-jointed, and sometimes wholly indistinguishable. Ocelli present. Proboscis sometimes short, with broad labella; usually projecting from the oral cavity, sometimes long and slender. Abdomen composed of from six to eight visible segments, slender in a few genera only. Legs moderately long and weak, with short, weak bristles or spines. Pulvilli

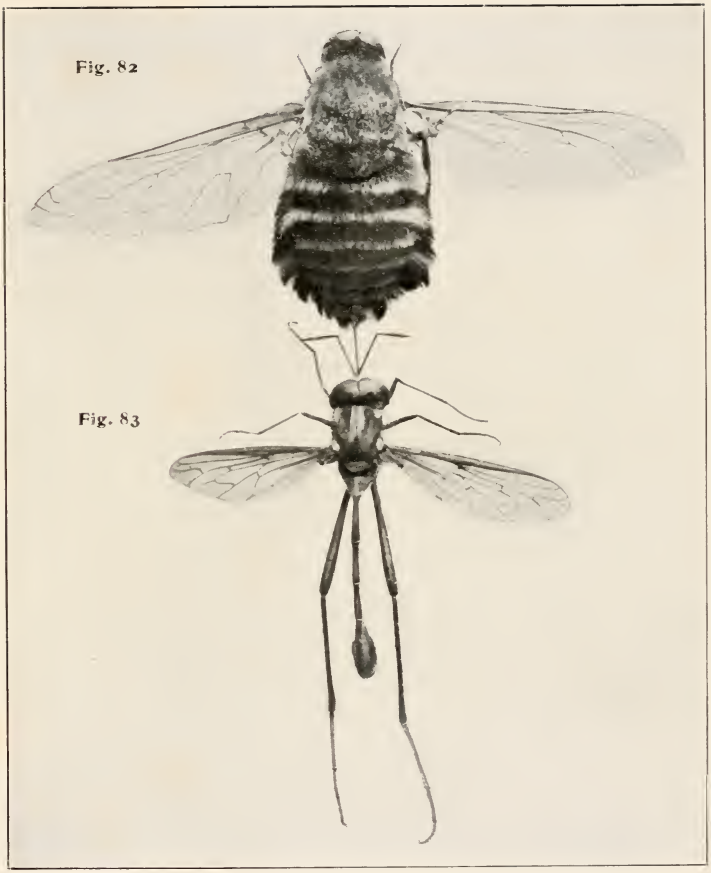


Fig. 82. *Oncodocera*, sp. (Brazil).
Fig. 83. *Systropus*, sp. (Brazil).

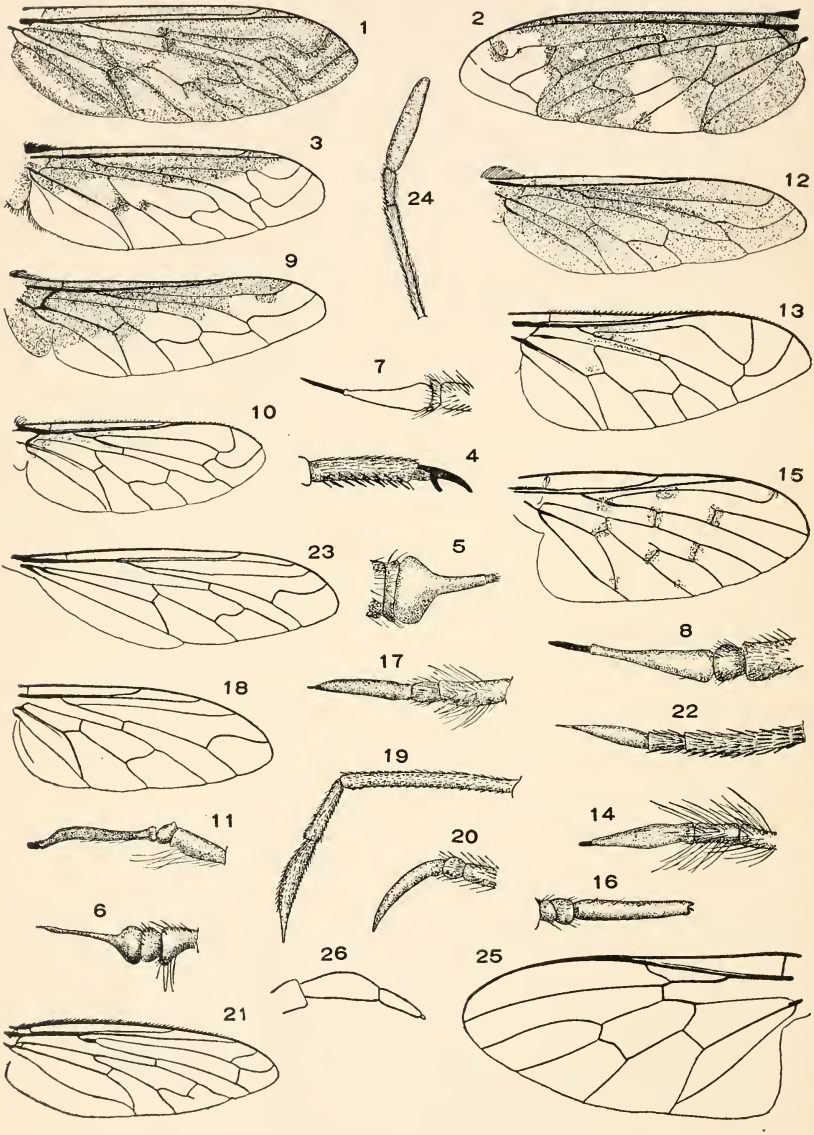
sometimes rudimentary, the empodia almost always so; tarsi and claws usually small. Squamæ small. Wings often with dark markings; two or more submarginal,* three or four, rarely five† posterior cells present; discal cell present in all our genera (absent in *Apolysa*, *Cyrtosia*); anal cell closed in or near the margin, or narrowly open.

Fig. 85. *Exoprosopa*, sp., enlarged one half. After Kellogg.

The family Bombyliidæ comprises about fifteen hundred known species. Most of them are swift-flying insects, often hovering motionless in the air for a time and darting away like a flash. They seek sunny places in woodland roads, about blossoms or on rank vegetation. The Anthracinæ are a group especially characteristic of arid regions. In general the members of the family are prettily and delicately marked, and their life histories are often very interesting. In the adult state they are

* The aberrant genus *Mythicomyia* described as an empidid, may possibly belong in this family. Without expressing an opinion as to its real relationships, it will be easily recognized by its very short second longitudinal vein, and its single submarginal cell. See figs. 25 and 26, and fig. 12 of the Empididæ.

† The presence of but four posterior cells in most members of this family, as doubtless in other forms having a like number, is due to the loss of the vein between the third and fourth cells, and not to the coalescence of veins. Certain species of *Anthrax*, and perhaps of other genera, have this vein persistent or vestigial. In those species having but three posterior cells the reduced number is likewise due to the loss of the vein between the second and third cells, so that the second posterior cell in such forms is really the coalesced second, third and fourth posterior cells (see figs. 1 and 21). This does not accord with the Comstock-Needham system of nomenclature, but I believe is certainly demonstrable.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flower flies, feeding upon the pollen and honey within the blossoms, extracted by aid of their often long proboscis. The larvæ of species of *Aphœbantus* and *Systœchus*, occurring in western America, are found in the egg-pods of the locust, *Caloptenus spretus*. 'The larvæ begin to transform themselves into the pupa state early in the summer, and the pupa pushes itself half way out of the ground in order to disclose the fly. They continue to issue during the summer months. *Aphœbantus* is first observed as a yellowish white grub, about half an inch long when extended, it being usually curved so that the head and tail nearly meet. It is usually found in a case of locust eggs which it has devoured, pushing the empty shells aside, and at last occupying the space where were twenty-one to thirty-six eggs. Often it is found in a little space below a number of egg-cases, as though it had feasted off the contents of several nests' (Riley). The larvæ of *Anthrax* have been found parasitic upon *Megachile*, *Osmia*, *Odynerus*, *Mamestra*, *Noctua* and *Agrotis;* those of *Spogostylum* upon *Pelopœus*, *Megachile*, *Cemonus*, *Osmia*, *Cicindela* and *Calicodoma;* those of *Bombylius* upon *Andrena* and *Collettes;* those of *Toxophora* upon *Eumenes;* those of *Callostoma* in the egg-cases of *Caloptenus italicæ;* those of *Systropus* upon *Limacodes*.

Fig. 86. Bombyliidæ. 1, *Anthrax*, wing; 2, *Hyperalonia*, wing; 3, *Exoprosopa*, wing; 4, *Exoprosopa*, hind claw; 5, *Spogostylum*, antenna; 6, *Anthrax*, antenna; 7, 8, *Exoprosopa*, antennæ; 9, *Bombylius*, wing; 10, *Pantarbes*, wing; 11, *Pantarbes*, antenna, 12, *Systoechus*, wing; 13, *Lordotus*, wing; 14, *Lordotus*, antenna; 15, *Phthiria*, wing; 16, *Phthiria*, antenna; 17, *Sparnopolius*, antenna; 18, *Geron*, wing; 19, 20, *Geron*, antennæ; 21, *Toxophora*, wing; 22, *Toxophora*, antenna; 23, *Systropus*, wing; 24, *Systropus*, antenna; 25, *Mythicomyia*, wing; 26, *Mythicomyia*, antenna.

TABLE OF GENERA.

1. The bifurcation of the second and third veins takes place opposite or nearly opposite the anterior cross-vein, the distance not exceeding the length of the cross-vein; the second vein forms a knee at its origin, the third vein in a straight line with the prefurca. 2

   The bifurcation of the second and third veins takes place at a greater distance from the cross-vein, usually at an acute angle. 12

2. Antennal style distinct, that is it is separated from the third joint or the styliform prolongation of the joint by a distinct suture. 3

   The third joint not with a distinct, suturally separated style, the style when present very minute. 7

3. Antennal style with a pencil of hairs at the tip; pulvilli distinct; front tibiæ with bristles. 4

   Antennal style not terminating in a pencil of hairs; three or four submarginal cells present. 5

4. Outer submarginal cell bisected by a cross-vein (*Coquillettia*, preoc.) . . . . . **Spogostylum.**

   Outer submarginal cell not bisected by a cross-vein; the anterior branch of the third vein sometimes connected with the second by a cross-vein forming three submarginal cells (*Argyramœba*) (**5**). . . . . **Spogostylum.**

5. Pulvilli distinct (**10, 10a**, p. 80). . . . . **Aldrichia.**

   Pulvilli vestigial or wanting. 6

6. Outer submarginal cell divided by a cross-vein, making four submarginal cells (**2**). . . . . **Hyperalonia.**

   Outer submarginal cell not divided by a cross-vein; posterior claws with a basal tooth (fig. 85, **3, 4, 8**). . . . **Exoprosopa.**

7. Eyes of male contiguous at the vertex; anal cell closed. **Astrophanes.**

   Eyes of male not contiguous at vertex; anal cell open. . . . 8

8. Anal cell widest at the middle. 9

   Anal cell widest at the margin. . . . . **Mancia.**

9. The second vein strongly contorted at the distal end in the shape of a recumbent letter S; three submarginal cells present. **Dipalta.**

   The second vein not so contorted at end. 10

10. Three submarginal cells normally present; proboscis elongate (*Stonyx*). . . . . **Anthrax.**

    Two submarginal cells normally present. 11

11. The contact of the discal cell with the third posterior not much longer than its contact with the fourth posterior; proboscis long; sides of the abdomen with a fringe of scales and not with hairs only. . . . . **Lepidanthrax.**
The contact of the discal cell with the third posterior at least twice as long as its contact with the fourth posterior; the latter contact often merely punctiform (**1, 6**). . . . **Anthrax.**

12. Wings with three posterior cells. 39
Wings with four posterior cells. 13

13. First posterior cell closed, or at most very narrowly open (*Parabombylius*). 14
First posterior cell open. 21

14. Three submarginal cells. 15
Two submarginal cells. 16

15. Head broader than thorax; posterior orbits not excised (**10, 11**). **Pantarbes.**
Head narrower than thorax, posterior orbits excised. **Triplasius.**

16. First basal cell longer than the second. 17
First basal cell not longer than the second; the anterior cross-vein situated near the base of discal cell. 20

17. Proboscis very short, not protruding beyond oral margin; anal cell usually closed; frontal triangle of male large, the eyes narrowly contiguous; large species (*Anisotamia*). **Oncodocera.**
Proboscis more or less elongate; anal cell usually open. . 18

18. First posterior cell closed at some distance from the border of the wing. 19
First posterior cell narrowed, or closed in or near the border of the wing; front with a silvery spot on each side below; rather small species (5-8 mm). . . . . **Parabombylius.***

19. Head comparatively small; the emargination of the occipital orbits almost imperceptible (fig. 84, **9**). . . . **Bombylius.**
Head broad; emargination of the occipital orbits distinct. **Heterostylum.**

20. Face thickly clothed with pile. . . . **Anastœchus.**
Face sparsely clothed with pile (**12**). . . **Systœchus.**

* *Bombylius ater, syndesmus, albopenicillatus, dolorosus.*

21. Two submarginal cells present. 26
Three submarginal cells. 22

22. Bare species; tibiæ without bristles; abdomen narrow. **Amphicosmus.**
More or less pilose species; tibiæ with bristles. . . . 23

23. Antennæ as long as the head, the third joint not longer than the first two together. 24
Antennæ shorter than the head; the third joint twice as long as the first two together. . . . . **Exepacmus.**

24. First antennal joint not thickened. 25
First antennal joint extraordinarily thickened. . . **Ploas.**

25. 'Scutellum deeply sulcate longitudinally'. . . **Geminaria.**
Scutellum convex; not sulcate (**13, 14**). . . **Lordotus.**

26. Anal cell open. 29
Anal cell closed. 27

27. Proboscis short; frontal triangle of male large (fig. 82). **Oncodocera.**
Proboscis elongate. 28

28. Third joint of the antennæ with long bristly hairs; face with long hair. . . . . **Acreotrichus.**
Third joint of antennæ without, or with short bristly hairs above; face bare or short pilose (**15, 16**). . . . **Phthiria.**

29. Body clothed with more scales than hairs, gibbous; antennæ long, the first joint unusually long (**20, 21,** p. 80). **Lepidophora.**
Body clothed chiefly with hair, or nearly bare. . . . 30

30. Alulæ wholly wanting; thorax and posterior margins of the abdominal segments with bristles; all the tibiæ with bristles; first and third antennal joints subequal. . **Sphenoidoptera.**
Flies not having the above assemblage of characters. . . 31

31. Body more or less pilose; tibiæ usually bristly. . . . 32
Body bare; tibiæ bare or feebly bristly. 37

32. Both basal cells of nearly equal length (**17**). **Sparnopolius.**
First basal cell distinctly longer than the second. . . 33

33. Third antennal joint but little longer than the first; mesonotum of male sometimes muricate and the costa denticulate (**19,** p. 80). **Eclimus.**

Third joint of antennæ more than twice the length of the first, bulbous at the base. 34

34. The origin of the second section of the second vein is before the proximal end of the discal cell in an acute angle.. . . 35
The origin of the second section of the second vein is beyond the proximal end of the discal cell and is rectangular.
Desmatoneura.

35. Third antennal joint scarcely longer than wide. . **Eucessia.**
Third antennal joint much longer than wide. . . . 36

36. Face projecting in profile. . . . . **Epacmus.**
Face retreating in profile. . . . . **Aphœbantus.**

37. Ocellar tubercle situated near vertex. 38
Ocellar tubercle situated near middle of front. **Metacosmus.**

38. Antennæ elongate, third joint flattened, the style broad and distinctly composed of two segments (**8, 9**, p. 80, type).
Desmatomyia.
Antennæ not elongated nor with such a style. **Paracosmus.**

39. Slender, elongate species, with slender legs. . . . 40
Shorter, more thick-set species, the abdomen never cylindrical. 41

40. Both males and female holoptic; abdomen enlarged at extremity (fig. 82, **23, 24**). . . . . **Systropus.**
Males holoptic, the females dichoptic; abdomen cylindrical, not enlarged at extremity (**11**, p. 80). . . **Dolichomyia.**

41. Three submarginal cells. 42
Two submarginal cells (**18, 19, 20**). . . . . **Geron.**

42. Body clothed with more scales than hairs, usually with thoracic bristles; abdomen decumbent; antennæ long (**21, 22**).
Toxophora.
Body clothed chiefly with hair; abdomen not decumbent.
Rhabdopselaphus.

XXV. Family EMPIDIDÆ.

BY PROF. A. L. MELANDER.

Flies ranging in size from three-fourths of a millimeter to fifteen millimeters, though rarely more than ten millimeters in length. Head more or less spherical, loosely connected with the thorax. Males holoptic or dichoptic, the front never excavated. Ocelli present. Antennæ porrect, approximated at their base, composed of two or three simple joints; third joint variable in shape, with or without a terminal style or arista, the latter rarely dorsal in position. Face without mystax, or fringe-like row of bristles on the oral margin. Proboscis short or long, usually rigid, projecting downward, forward or backward. Thorax sometimes very convex. Male genitalia usually prominent and of complicated structure; ovipositor simple. Squamæ small. Legs usually slender, often with structural peculiarities, such as the coxæ or femora lengthened, femora or tibiæ thickened and spinose, or with projections or fringes of scales, the metatarsi flattened, etc. Pulvilli usually distinct; empodia usually membranous and linear. Venation variable; discal cell occasionally absent; the third longitudinal vein furcate or not; three or four posterior cells present, anal cell longer or shorter than the second basal cell, closed before the margin of the wing, sometimes wholly wanting.*

The family Empididæ is a large and complex one, in-

* *Hilarimorpha* and *Mythicomyia* (fig. 12, and figs. 25, 26 Bombyliidæ) have been included in the Empididæ. Both of these genera have the anal cell narrowly open or closed in the border and are wholly bristleless. The former genus will be found under the Leptidæ; the latter is figured with the Bombyliidæ.

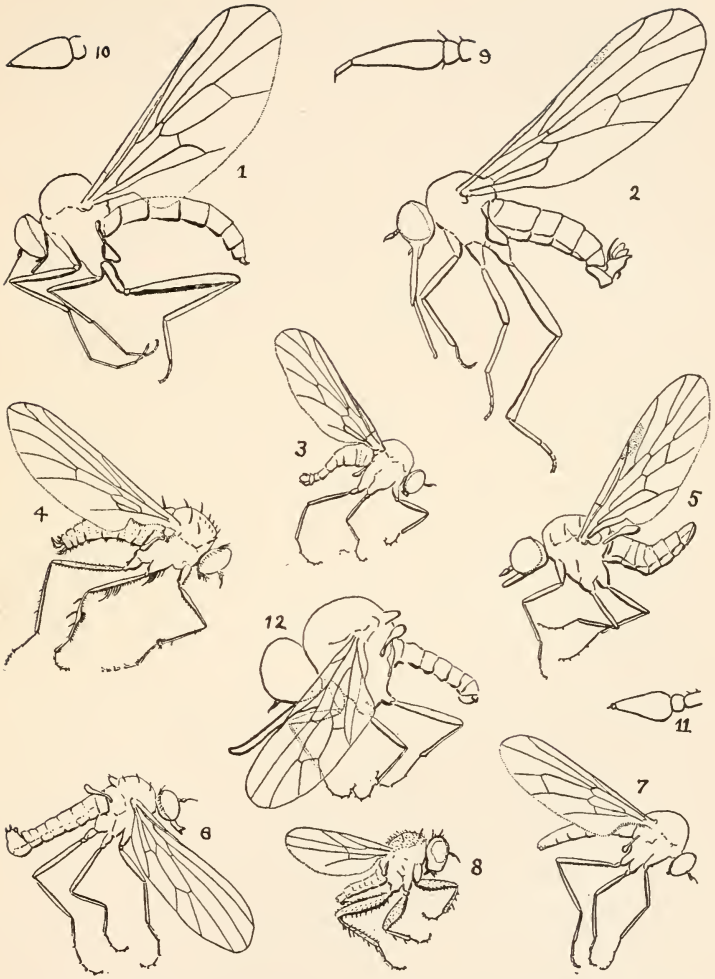


Fig. 87. Empididæ. 1, *Hybos;* 2, *Toreus;* 3, *Hesperempis;* 4, *Oreogeton;* 5, *Prorates;* 6, *Heleodromia;* 7, *Ocydromia;* 8, *Coloboneura;* 9, *Toreus*, antenna; 10, *Prorates*, antenna; 11, *Hesperempis*, antenna; 12, *Mythicomyia*. Drawings by A. L. Melander.

cluding many genera and species. Most of the species can be recognized by their spherical head, large eyes, piercing proboscis, large thorax and slender legs and abdomen. Some of the minute forms resemble certain of the Platypezidæ or smaller muscids. The members of the family are for the most part modest in coloration, gray, blackish or reddish; a few tropical forms are metallic. They are all predaceous, preying upon smaller flies, which they impale on their proboscis. *Microphorus* and *Anthalia* and their allies, are common visitors to flowers. Some species of *Rhamphomyia*, *Empis* and *Hilara* dance in the air in immense swarms. The species of *Clinocera* are sluggish, and may be found along the banks of streams. *Tachydromia* runs swiftly over stones in search of prey. Some species of *Hilara* and *Empis* construct peculiar frothy balloons at mating time. The peculiar armature of the legs is mostly a sexual characteristic possessed by the males. Empididæ are especially abundant in mountainous, damp and woody regions during the early summer; they are pre-eminently a boreal group. In dry regions they are rare, perhaps a result of the dominance of the related but more powerful Asilidæ.

The larvæ of this family are nearly cylindrical, tapering anteriorly, with a very small and partly retracted head. The abdominal segments have more or less prominent prolegs. The larvæ live in decaying vegetable matter or in running streams; the pupæ are free. The early stages of Empididæ are but little known.

TABLE OF GENERA.

1. Anal cell wanting or incomplete; discal cell always united with the second basal; three posterior cells; third longitudinal vein simple; antennæ two or three-jointed; femora often thickened and mucronate below. . . . . **Tachydromiinæ.**

Anal cell complete; or, if incomplete, the front coxæ are greatly lengthened; often four posterior cells; third longitudinal vein often furcate. 2

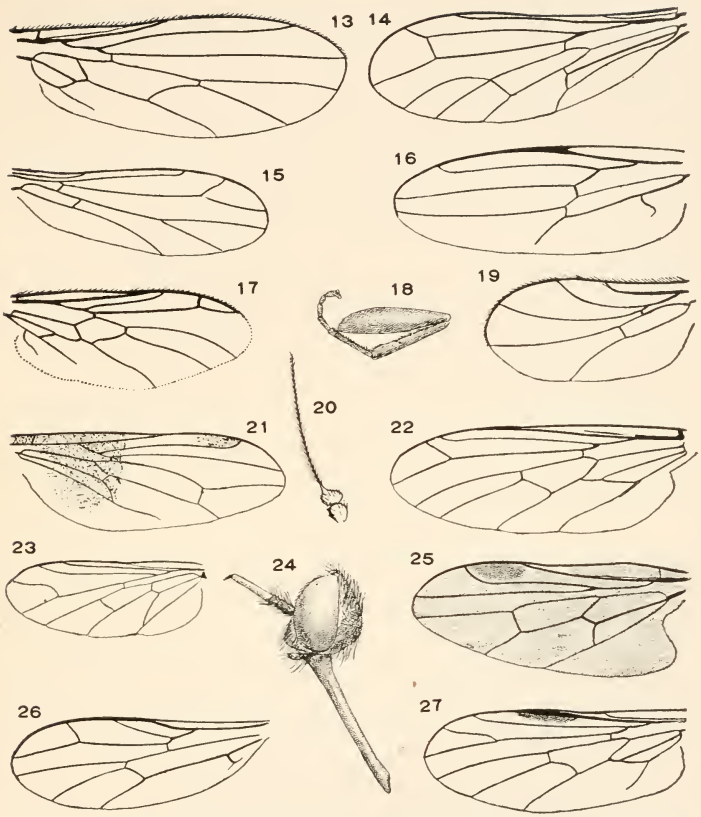


Fig. 88. Empididæ. 13, *Oreothalia*, wing; 14, *Blepharoprocta*, wing; 15, *Microdromia*, wing; 16, *Tachypeza*, wing; 17, *Lamprempis*, wing; 18, *Tachypeza*, front leg; 19, *Drapetis*, wing; 20, *Drapetis*, antenna; 21, *Hybos*, wing; 22, *Empis*, wing; 23, *Geron* (Bombyliidæ), wing; 24, *Empimorpha*, head; 25, *Syneches*, wing; 26, *Neoplasta*, wing; 27, *Hilara*, wing.

2. Anal angle of wing not projecting, the outline of wing nearly cuneiform; front coxæ more or less lengthened; proboscis short, fleshy, or sharp and incurved. . . **Hemerodromiinæ.**

Anal angle of wing more or less projecting, often rectangular; wings not uniformly tapering to the base; front coxæ not elongate; proboscis usually rigid. 3

3. Anal cross-vein forming a distinct angle with the basal part of the anal vein; proboscis rarely longer than head; thorax often large. 4

Anal cross-vein recurved and confluent with the anal vein, or forming part of the posterior side of the anal cell; proboscis often elongate, rarely projecting forward; antennæ usually three-jointed. . . . . **Empidinæ.**

4. Anal cell as long as the second basal, or longer, its outer angle acute. 5

Anal cell shorter than the second basal, its posterior angle obtuse or the anal cross-vein perpendicular to the anal vein; proboscis short, rarely porrect; thorax seldom excessively convex. **Ocydromiinæ.**

5. The discal cell emits three veins; proboscis short, sharp and incurved; thorax comparatively small; antennæ three-jointed. **Brachystomatinæ.**

The discal cell emits two veins; proboscis rigid, projecting forward; thorax greatly arched; antennæ two-jointed. **Hybotinæ.**

TACHYDROMIINÆ.

1. Both the sixth vein and the anal cross-vein present, though sometimes feeble. 2

Both the sixth vein and the anal cross-vein completely wanting. 3

The sixth vein wanting, the anal cross-vein present; marginal cell long along the costa; first basal cell shorter than the second; front femora thickened; eyes contiguous below the antennæ; palpi small, with an apical bristle; humeri constricted from the notum (16, 18). . . . . **Tachypeza.**

2. Front and middle femora thickened; middle femora with a double row of spines below; middle tibiæ ending in a sharp spur; palpi broad. . . . . **Platypalpus.**

Femora not thickened; middle legs without spurs and with minute or no spines; basal cells subequal. **Symballophthalmus.**

3. First and second basal cells nearly equal; eyes widely separated; more or less pollinose species. 4

First basal cell much shorter than the second; eyes contiguous below the antennæ; shining species. 6

4. Arista dorsal; wings less than one-third the length of the abdomen. **Thinodromia.**

Arista terminal or nearly so; wings surpassing the abdomen. 5

5. Antennæ three-jointed: legs thick and bristly (8). **Coloboneura.**
   Antennæ two-jointed; legs but little thickened and with few bristles. . . . . **Chersodromia.**
6. Arista dorsal; other characters as in *Drapetis*. . **Stilpon.**
   Arista terminal or subterminal. 7
7. Humeri not constricted from the mesonotum; thorax broader than the abdomen; second longitudinal vein short, and gently curved forward; the second and third sections of the costa subequal; palpi broad (19, 20). . . . . **Drapetis.**
   Humeri constricted from the mesonotum; thorax not broader than the abdomen; second longitudinal vein straight until near the end; palpi narrow. 8
8. Second longitudinal vein abruptly recurved at tip; second section of costa shorter than the third. . . . **Phoneutisca.**
   Marginal cell lengthened; second section of costa longer than the third. . . . . **Tachydromia.**

HEMERODROMIINÆ.

1. Front legs raptorial, the front coxæ and femora subequal in length; front femora and tibiæ spinose below. . . . 2
   Legs very slender and without spines; front coxæ not greatly lengthened. 3
2. Third longitudinal vein simple; discal cell emitting three posterior veins; antennæ with a long arista. . . . **Chelipoda.**
   Third longitudinal vein branched; antennæ with a short style. **Hemerodromia.**
   a. Anal and discal cells present. . . . . b
      Discal cell open. c
   b. Second posterior cell pedunculate. subgenus **Hemerodromia.**
      Second posterior cell sessile. . subgenus **Cladodromia.**
   c. Anal cell wanting (15). . . subgenus **Microdromia.**
      Anal cross-vein present. . . . . d
   d. Second posterior cell petiolate. . . subgenus **Metachela.**
      Second posterior cell sessile (26). . subgenus **Neoplasta.**
3. Proboscis short, sharp and incurved; outer antennal joint conical, with a moderately long style; anal cross-vein perpendicular to hind margin of wing. 4
   Proboscis vertical, usually soft; outer antennal joint short ovate, with a lengthened arista; anal cell usually rounded at tip. 5
4. Second posterior cell petiolate. . . . **Rœderiodes.**
   Second posterior cell sessile. . . . . **Boreodromia.**

5. Third longitudinal vein simple. 6
Third longitudinal vein branched. 7

6. Anal cross-vein parallel with the hind margin of the wing (13). **Oreothalia.**
Anal cross-vein perpendicular to the hind margin of the wing (6). **Heleodromia.**

7. Head longer than broad, extending forward; wings brown with numerous pale spots. . . . . **Dolichocephala.**
Head transverse, nearly vertical. . . . . **Clinocera.**

BRACHYSTOMATINÆ.

Anterior branch of third vein terminates in the second vein (14). **Blepharoprocta.**
The anterior branch of the third vein terminates in the costa. **Brachystoma.**

HYBOTINÆ.

1. Fourth vein forked; hind femora slender. 2
The discal cell emits two simple posterior veins; hind femora more or less thickened; antennæ with a slender arista. . . 3

2. Third longitudinal vein furcate; no antennal style (5, 10) **Prorates.**
Third vein simple; antennæ with a thickened style. **Meghyperus.**

3. The second vein arises near the base of the wing (25). **Syneches.**
The second vein arises near the middle of the wing. . . 4

4. Vein between basal cells indistinct. . . . . **Syndyas.**
Veins between basal cells strong (1, 21). . . . **Hybos.**

OCYDROMIINÆ.

1. Discal cell present. 2
Discal cell wanting. 9

2. The discal cell emits three simple posterior veins. . . . 3
First posterior vein obsolete; antennæ with a long, slender arista. 8

3. Third antennal joint short, ovate, pointed, with a long arista; third longitudinal vein simple. . . . . **Parathalassius.**
Antennæ with a short, thick style. 4

4. Third longitudinal vein furcate; last antennal joint short and broad. **Hormopeza.**
Third vein simple. 5

5. Hind femora spinose below, thickened; hind tibiæ shortened, bowed near the knee; last antennal joint large. . **Oedalea.**

Hind legs slender and not spinose. 6

6. Last antennal joint short and broad, with a short, thick style; proboscis short. . . . . **Anthalia.**
Last antennal joint lanceolate or elongate cylindrical; its style short. 7

7. Proboscis rigid, directed forward, about as long as height of head. **Euthyneura.**
Proboscis short, fleshy, not directed forward. . . **Trichina.**

8. Last antennal joint conical, arista terminal. . **Leptopeza.**
Last antennal joint oval, arista subdorsal. (7) . **Ocydromia.**

9. Fourth and fifth longitudinal veins weak, sometimes confluent basally. . . . . **Bicellaria.**
All longitudinal veins strong, simple; hind metatarsi thickened; last antennal joint oval. . . . . **Microsania.**

EMPIDINÆ.

1. Third longitudinal vein simple. 2
Third vein furcate. 5

2. Proboscis not longer than height of head, porrect; outer antennal joint attenuated beyond the broad base and with an elongated style. . . . . **Microphorus.**
Proboscis longer than height of head; antennæ plainly three-jointed. 3

3. Proboscis porrect; third antennal joint long and slender; its style minute. . . . . **Anthepiscopus.**
Proboscis rigid, projecting downward; third antennal joint conical. 4

4. Face bare. . . . . **Rhamphomyia.**
Face hairy. . . . . **Neocota.**

5. Metapleuræ bearing a cluster of hairs or bristles. . . . 6
Metapleuræ bare.. 10

6. Proboscis longer than height of head, rigid. 7
Proboscis short and fleshy (4). . . . . **Oreogeton.**

7. First antennal joint elongate, third antennal joint subcylindrical, with a minute style; mesonotum without bristles; color metallic (17). . . . . **Lamprempis.**
First antennal joint not elongate; third joint conical, with a longer, thickened style; mesonotum with bristles; color rarely metallic. 8

8. Legs robust, all the femora of nearly equal length; males dichoptic. **Pachymeria.**
   Hind legs longer than the others, their femora but little thickened; males sometimes holoptic. 9

9. Face hairy (**24**). . . . . **Empimorpha.**
   Face bare (**22**). . . . . **Empis.**

10. Auxiliary vein short, recurved at its end to meet the costa; proboscis shorter than height of head; front metatarsi of male usually swollen (**27**). . . . . **Hilara.**
    Auxiliary vein straight, extending to near the middle of the wing, evanescent at its tip so as not to meet the costa; male front metatarsi but rarely swollen. 11

11. Body and legs without bristles; the costal vein encompasses the entire wing. 12
    Body and legs with bristles. 13

12. Proboscis much longer than head (**2, 9**). . . . **Toreus.**
    Proboscis shorter than head (**3, 11**). . . **Hesperempis.**

13. Proboscis porrect, about as long as height of head; palpi prominent; nearly as long as the proboscis; third antennal joint nearly cylindrical, its style minute; hypopygium usually with a pair of dorsal processes; males holoptic. . **Iteaphila.**
    Proboscis shorter; males dichoptic. 14

14. Third antennal joint short oval, with a rather short and thick style; proboscis horizontal (South America). **Apalocnemis.**
    Third antennal joint elongate; proboscis vertical. . . 15

15. Femora more or less thickened; much longer than the tibiæ; third antennal joint long, nearly cylindrical; thorax and legs with few bristles (South America). . . . **Haplomera.**
    Femora not thickened nor longer than the tibiæ; third antennal joint conical. (South America.) . . . **Hilarempis.**

Anthalia Zetterstedt, Ins. Lapp. (1838), 538.
Anthepiscopus Becker, Wien. ent. Zeit. (1891), 281.
Apalocnemis Philippi, Verh. k. k. zool.-bot, Gesellsch., (1865), 752.
Bicellaria Macquart, Soc. Sci. Agr. Arts. Lille, (1823), 155.
Chelipoda Macquart, Soc. Sci. Agr. Arts, Lille (1823), 148.
Chersodromia Walker, List. Dipt. Ins. Brit. Mus. iv, (1849), 1157.
Cladodromia Ann. Mus. Nat. Hung. (1905), 453.

Dolichocephala Macquart, Soc. Sci. Agr. Arts, Lille (1823), 147.
Haplomera Macquart, Dipt. Exot., I, (1838), 279.
Hesperempis Melander, Ent. News, (1906), 377.
Hilarempis Bezzi, Ann. Mus. Nat. Hung. (1905), 443.
Metachela Coquillett, Proc. Ent. Soc. Wash. V, (1903), 253.
Microdromia Bigot, Ann. Soc. Ent. Fr. (1857), 557.
Microsania Zetterstedt, Ins. Lapp. (1838), 534.
Parathalassius Mik. Wien. ent. Zeit. X, (1891), 217.
Prorates Melander, Ent. News (1906), 372.
Symballophthalmus Becker, Wien. ent. Zeit. VIII, (1889), 285.
Tachypeza Meigen, Syst. Beschr. VII, (1838), 95.
Thinodromia Melander, Ent. News, (1906), 370.
Toreus Melander, Ent. News, (1906), 376.
Trichina Meigen, Syst. Beschr. VI, (1830), 335.

XXVI. Family DOLICHOPODIDÆ.

BY PROF. J. M. ALDRICH.

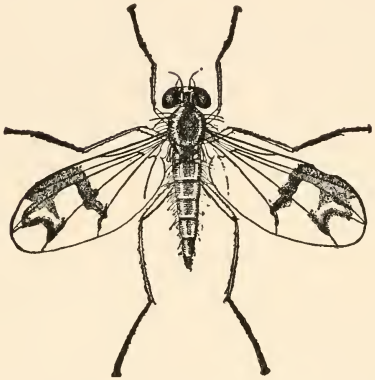


Fig. 89. *Psilopodinus sipho*, enlarged. After Lugger.

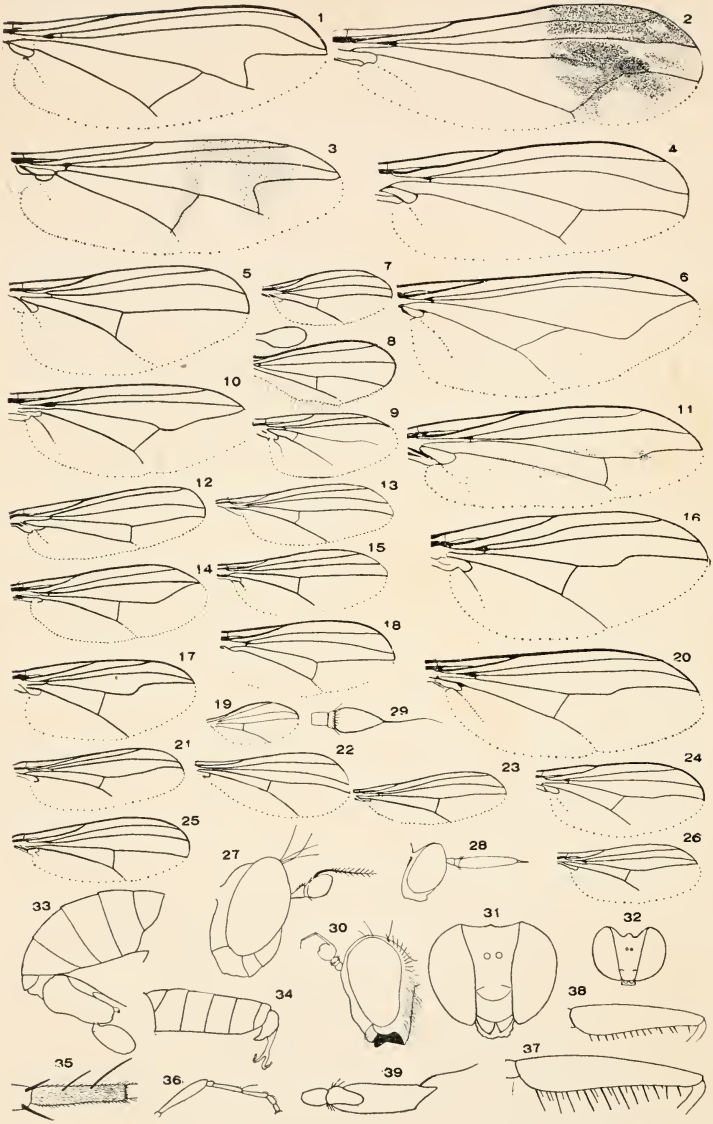
Small flies, never exceeding 9 mm. in length, almost always green in ground color, usually shining, more rarely dusted with grey or brown, sometimes pure yellow or almost black. As a family they are distinguished from their nearest allies by the absence of the cross-vein between the discal and second basal cells, these uniting to form a single cell.

Head about as wide as the thorax, usually a little wider than high; the face bare, varying much in width in different genera, in the females generally wider than in males of the same species; front widening rapidly above in nearly all genera (in *Diaphorus* the eyes sometimes contiguous on the front), with bristles on the vertex only. Posterior orbit with a row of short, erect bristles, indistinct below in some genera. Proboscis fleshy, short, retracted, or rarely a little protruding; palpi flat, reposing

on the proboscis in most species. Antennæ three-jointed, inserted more or less above the middle of the eyes, close together, the first two joints always short: third joint commonly oval, but in several genera lengthened, sometimes more so in the male; arista dorsal, subapical, or completely apical. Thorax in some genera with a well-marked flat or concave area in front of the scutellum on the dorsum. Abdomen conical or a little compressed, in *Hydrophorus* and *Scellus* sometimes peculiarly small and retracted; hypogygium varying much in form in different species, generally rather conspicuous. Coxæ generally short, legs in most genera of moderate length, in some elongate, those of the males frequently developed into some ornamental structure; the front femora are thickened in a few genera. Wings generally hyaline, yet often with dark markings, which may take the form of a definite pattern, or may follow the veins indistinctly, or may be evenly diffused. Anal cell always very short; two or three posterior cells; sixth vein always very short, sometimes absent.

This family perhaps surpasses any other natural group of animals in the variety of secondary sexual characters possessed by the males. These are ornaments, and are paraded before the females, as are similar ornaments in the peacock and turkey-cock. They may occur in the tarsi, tibiæ, femora, wing-apex, face, third joint of antenna, arista, palpi, and still other places. Contrary to the usual theory, these characters seem very constant, and are the main reliance in distinguishing the species. Identification in the family is rendered delightfully easy in the majority of cases, if one has the male.

The larvæ are almost wholly unknown in the United States; several species have been worked out in Europe. They are found in moist earth rich in decaying vegetation, upon which they feed: Dr. A. D. Hopkins has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found larvæ of *Medeterus* in burrows of Scolytidæ, and thinks them predaceous. According to Sharp, the larvæ are amphipneustic, 'a cocoon is formed and the pupa is remarkable on account of the existence of two long horns bearing the spiracles, on the back of the thorax; the seven pairs of abdominal spiracles being excessively minute.'

In adult life all are predaceous, capturing chiefly the minuter soft-bodied flies, which they enclose within their soft labella, after the manner of *Scatophaga*, while extracting the juices.

As to their immediate habitat, Dolichopodidæ are generally very uniform within the species, but within the genus two or three habitats may be occupied. The following list of places preferred is referred to by letter in the table of genera, and may be of use to collectors.

a. On foliage in shady places.
b. On foliage in the sun.
c. On grass.
d. On wet earth at edge of water.
e. On surface of water.
f. On stones in streams.
g. On bark of trees.
h. On rocks in cold, wet places.
i. On sea beaches.
j. On old logs.

None of the species are attracted to flowers or to light.

Fig. 90. Dolichopodidæ. 1, *Psilopus unifasciatus*, wing; 2, *Liancalus similis*, wing; 3, *Psilopodinus sipho*, wing; 4, *Hypocharassus, gladiator*, wing; 5, *Diaphorus spectabilis*, wing; 6, *Plagioneurus univittatus*, wing; 7, *Xanthochlorus helvinus*, wing; 8, *Achalcus* n. sp. wing (22 diam.); 9, *Asyndetus syntormoides*, wing; 10, *Tachytrechus sanus*, wing; 11, *Scellus vigil*, wing; 12, *Hydrophorus eldoradensis*, wing; 13, *Nothosympycnus frontalis*, wing; 14, *Pelastoneurus vagans*, wing; 15, *Gymnopternus phyllophorus*, wing; 16, *Argyra albicans*, wing; 17, *Mesorhaga albiciliata*, wing; 18, *Medeterus aurivittatus*, wing; 19, *Thrypticus willistoni*, wing; 20, *Dolichopus tenuipes*, wing; 21, *Neurigona lateralis*, wing; 22, *Parasyntormon montivagum*, wing of male; 23, *Sympycnus pugil*, wing of male; 24, *Rhaphium lugubre*, wing; 25, *Aphrosylus prædator*, wing; 26, *Hercostomus unicolor*, wing; 27, *Pelastoneurus vagans*, head; 28, *Rhaphium lugubre*, head of male; 29, *Porphyrops effilatus*, antenna; 30, *Hydrophorus eldoradensis*, head; 31, *Pelastoneurus vagans*, head of male from in front; 32, *Mesorhaga albiciliata*, head from in front; 33, *Dolichopus tenuipes*, abdomen of male, side view; 34, *Porphyrops effilatus*, abdomen of male; 35, *Dolichopus idahoensis*, hind metatarsus; 36, *Nothosympycnus fortunatus*, front tibia and tarsus of male; 37, *Scellus virago*, front femur; 39, *Parasyntormon emarginatum*, antenna of male, inner side.

All wings enlarged nine diameters, except fig. 8, where the corresponding size is shown in outline. Figs 36 and 39 after Wheeler, all others by J. M. Aldrich from nature.

TABLE OF GENERA.

1. Fourth longitudinal vein with a widely divergent fork on the front side (1, 3). 2
Fourth longitudinal vein generally without fork; if one is present it is parallel with the main vein. 4

2. Cilia of the tegulæ black, third vein converging to the fourth at tip (3), scutellum with four large bristles (b). **Psilopodinus.**
Cilia of tegulæ pale, third vein curving forward at tip (1), scutellum with two large and generally two small bristles. . 3

3. Face wide, vertex deeply excavated (a). . . **Psilopus.***
Face narrow, vertex scarcely excavated. . **Leptorhethum.**

4. Thorax almost as broad as long; head wider than its height or than the thorax; face wide, vertex deeply excavated (17, 32). **Mesorhaga.**
Head and thorax not as described. 5

5. Fourth vein bent forward, forming an apical cross-vein; posterior cross-vein oblique, parallel with the margin of the wing (6, b). **Plagioneurus.**
Posterior cross-vein nearly transverse, usually no apical cross-vein. 6

6. Hind metatarsi with large bristles above (35, a, b, d). **Dolichopus.**
Hind metatarsi without large bristles above. . . . 7

7. Hypopygium long, extending forward under the venter (33). 8
Hypopygium short, not extending forward under the venter (34, one form). 20

8. Arista plumose (27). 9
Arista bare or pubescent. 11

9. Face wide, bulging on the lower part (27, 31, 14, a, d). **Pelastoneurus.**
Face narrow. 10

10. Third antennal joint of male large, elongated, excavated above. **Leptocorypha.**
Third antennal joint normal, as in fig. 27. . . **Sarcionus.**

11. Before the scutellum the posterior third of the dorsum is hollowed out, or at least distinctly flattened. 12
Before the scutellum convex as usual. 15

* *Igonosoma* of my Catalogue, 1905.

12. Posterior cross-vein distant much more than its own length from the margin of the wing (measured on the fifth vein, **19**). 13
Posterior cross-vein distant about its own length from the margin. 14

13. Second antennal joint prolonged along the inner side of the third. **Cœloglutus.**
Second antennal joint not so prolonged, or forming a cup for the third (**19**, b, c). . . . . **Thrypticus.**

14. Third and fourth veins parallel towards the tip (**25**, i). **Aphrosylus.**
Third and fourth veins convergent (**18**, g). . **Medeterus.**

15. The face of the male extends far below the eyes, hanging down apron-like before the mouth (f). . . . **Polymedon.**
The face of the male reaches about as far as the lower edge of the eyes, head vertically elongated (**10**, d, j). **Tachytrechus.**

Face of the male reaching as far as the lower edge of the eyes, but the head not elongated. . . . . **Paraclius.**
Face of the male not reaching as far as the edge of the eyes. 16

16. Third and fourth veins parallel towards the tip. . . . 17
Third and fourth veins distinctly convergent. . . . 19

17. Bristles of thorax yellow (**19**, b, c). . . . **Thrypticus.**
Bristles of thorax black. 18

18. First antennal joint bare above. . . . **Peloropeodes.**
First antennal joint hairy above (**15**, a). . **Gymnopternus.**

19. The last segment of the fourth vein gradually approaching the third (**26**, a, c, d, e, h). . . . . **Hercostomus.**
Last segment in the middle abruptly curving forward, then gradually resuming its former course, ending near the third vein. **Paraclius.**

20. Costal vein extending only to the tip of the third vein, the latter part of the fourth vein evanescent (**9**, b). . **Asyndetus.**
Costal and fourth veins normal. 21

21. First antennal joint hairy above. 22
First antennal joint bare above. 26

22. Fourth vein towards the tip strongly curved forward, nearly joining the third at the margin (**14**, **27**, **31**, d). **Pelastoneurus.**
Fourth vein parallel with the third, or slightly convergent. 23

23. Arista dorsal, face very narrow, palpi small. . **Anepsius.**

Arista dorsal, face wide, palpi large. 24
Arista nearly or quite at the tip of the large, pointed third joint. 25

24. Arista plumose. . . . . **Phylarchus.**
Arista pubescent (d). . . . . **Diostracus.**

25. Posterior cross-vein distant about its own length from the end of the fifth vein (**4**, i). . . . . **Hypocharassus.**
Posterior cross-vein much more than its own length from the end of the fifth vein (**16**, a, b, d). . . . . **Argyra.**

26. A concave or distinctly flattened bare space before the scutellum. 27
Thoracic dorsum convex as usual. 31

27. Bristles of thorax pale yellow (a). . . **Chrysotimus.**
Bristles black, rarely brownish. , ... 28

28. Fourth vein parallel with the third beyond the cross-vein, or nearly so. 29
Fourth vein converging towards the third (**21**, g). **Neurigona.**

29. Acrostichal bristles present only at the anterior edge of the thorax, very minute (**7**, a). . . . . **Xanthochlorus.**
Acrostichal bristles well developed, two-rowed. . . . 30

30. Very minute, blackish, opaque species (**8**). . **Achalcus.**
Small, yellow species. . . . . **Xanthina.**

31. Wings elongate, the posterior cross-vein beyond the middle, less than its length from tip of fifth vein (*Hydrophorinæ*). 32
Wings not elongate, posterior cross-vein scarcely beyond the middle, more than its length from end of fifth vein; if less, the hind metatarsus shorter than the following joint. . . 34

32. Fore femora slender (**2**, h). . . . . **Liancalus.**
Fore femora thickened, with spines below (**37, 38**). . . 33

33. Spines of fore femora very short, thoracic dorsum without well-marked pollinose lines (**12, 38**, d, e). . **Hydrophorus.**
Spines of fore femora long, dorsum with pollinose lines (**11, 37**, c, g). . . . . **Scellus.**

34. Outer appendages of the hypopygium long and filiform, arista dorsal. . . . . **Nematoproctus.**
Not with both characters. 35

35. Second joint of antenna with a thumblike projection along the inner side of the third (**39**). 36
Second joint not with such projection. 37

36. Face of female wide, the lower part projecting rooflike (a). **Syntormon.**
Face of female not so constructed (**22, 39,** a). **Parasyntormon.**

37. Eyes of male contiguous or nearly so below the antennæ. 38
Eyes of male contiguous or nearly so above the antennæ (**5**, a, b, c). . . . . **Diaphorus,** in part.
Eyes closest together at the level of the antennæ, middle legs of male distorted or with peculiar structure (c, d). **Campsicnemus.**
Eyes of male not contiguous nor closely approximated. . 41

38. Abdomen of male with five visible segments besides the nearly concealed hypopygium (a, b, d). . **Chrysotus,** in part.
Abdomen of male with six visible segments besides the hypopygium. 39

39. First joint of fore tarsus in the male much shorter than the second (**13, 36,** a, c) . . . . . **Nothosympycnus.**
First joint of fore tarsus of male longer than the second. . 40

40. Second longitudinal vein in the male strikingly sinuous. **Eutarsus.**
Second vein almost straight (a). . . . **Sympycnus.**

41. Thorax bright green, abdomen yellow, with a good deal of silvery pollen (a). . . . . **Leucostola.**
Not so marked. 42

42. Face broad, the palpi large, reposing on the proboscis; pollinose species (d, i). . . . . **Thinophilus.**
Palpi of ordinary size or else projecting lamelliform, free from the proboscis. 43

43. Third joint of antenna elongated in both sexes; in the male awl-shaped, not much wider at base than the first joint (**28**). **Rhaphium.**
Third joint elongated only in the male, lancet-shaped, much wider at base than the first joint (**29**, a). . . **Porphyrops.**
Third joint short, the tip sometimes drawn out into a point. 44

44. Abdomen of male with four blunt bristles at the tip (**5**, a, b, c). **Diaphorus,** in part.
Abdomen destitute of these bristles. 45

45. Arista nearly or quite apical (a, b, d). **Chrysotus,** in part.
Arista dorsal (d). . . . . **Teuchophorus.**

XXVII. Family PHORIDÆ.

BY C. T. BRUES.

Small or minute species with a hunchbacked appearance. Head small, rather flattened; front broad in both sexes, usually bearing a few strong bristles; face very short, concave. Oral opening large; the proboscis usually fleshy; the palpi projecting, large, generally with strong bristles. Eyes never very large, the ocelli always present in the winged forms. Antennæ with the third joint large and concealing the others, spheroid or pointed in shape, bearing a sub-dorsal or apical arista. Thorax usually large and arched, the scutellum rarely absent. Abdomen rather short, more or less narrowed behind, or oval, partly membranous in the wingless forms. Genitalia of the male often large, of the female usually very

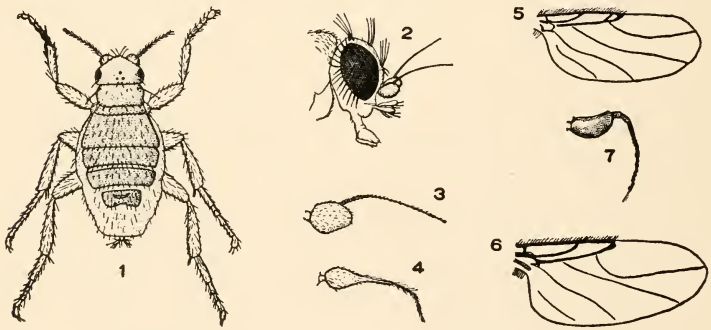


Fig. 91. Phoridæ. 1, *Puliciphora* ♀; 2, *Aphiochæta*, head; 3, *Phora*, antenna; 4, *Conicera*, antenna; 5, *Aphiochæta*, wing; 6, *Hypocera*, wing; 7, *Apocephalus*, antenna. Drawings by Mrs. C. T. Brues.

small and projecting. Ovipositor in *Apocephalus* and *Plastophora* hard, chitinized and projecting. Legs well devel-

oped; coxæ stout; femora large, the hind pair sometimes enlarged or flattened; tibiæ generally with a few strong bristles. Wings usually large, sometimes very small or entirely absent; with two heavy veins anteriorly which reach only half way to the apex of the wing, and three or four much lighter ones, which run obliquely across the discal portion of the wing.

Flies belonging to this family can always be recognized by the peculiar antennæ and wing venation. They are most frequently to be found about decaying vegetable matter, fallen leaves, dead insects, on windows, or in ant nests. Some have been observed to frequent corpses.

The larvæ are cylindrical and tapering in front. The pupa is oval, distinctly segmented, and bears two slender projections from the fourth segment which form the breathing organs. These are connected with the prothorax.

Their habits are extremely diverse. A number of species have been bred from decaying vegetables, fungi and other decomposing plant matter, while others feed on decaying caterpillars or other insects, as well as snails or other animals. A number live in ant nests, one (*Apocephalus*) as a parasite, and another (*Metopina*) as a commensal. In the case of the former the larva lives within the head of the adult ant, which finally drops off; while the larva of *Metopina pachycondylæ* lives curled about the neck of its host ant-larva, partaking of the food given the latter by the attendant worker ants. Still others live in the nests of certain burrowing bees and wasps, and one is known to be parasitic on spider eggs.

TABLE OF GENERA.

1. Wings fully developed. 2
   Wings absent, or much reduced in size and venation. . . 12

2. Third longitudinal vein forked near the tip. . . . 3
   Third longitudinal vein simple, at most thickened at tip. . 5

3. Costal vein and front destitute of strong setæ. **Gymnophora.**
Costal vein and front provided with strong setæ. 4

4. Anterior frontal setæ reclinate, middle tibiæ with one or more setæ on the outer side near the base. . . . **Phora.**
Anterior frontal setæ reclinate, middle tibiæ destitute of such setæ, ovipositor hard and polished. . . **Apocephalus.**
Anterior frontal setæ proclinate, middle tibiæ destitute of such setæ. . . . . **Aphiochæta.**

5. First longitudinal vein wanting. . . . **Ecitomyia**, male.
First longitudinal vein present as usual. 6

6. Anterior frontal setæ reclinate, middle tibiæ with one or more setæ on the outer side near the base. 7
Anterior frontal setæ proclinate, middle tibiæ without such setæ. 9

7. Velvet black, middle tibiæ of the male with a row of long setæ on the upper side. . . . . **Trineura.**
Not velvet black, middle tibiæ with only two or three setæ besides those at apex. 8

8. Male antennæ prolonged into a slender point with apical arista. Female antennæ with a slight point where the arista is inserted at the upper corner, seventh vein obsolete. . **Conicera.**
Third joint usually rounded in both sexes, seventh vein distinct. **Hypocera.**

9. Spurs of four posterior tibiæ well developed. . . . 10
Spurs of middle tibiæ wanting, those of posterior pair minute. 11

10. Ovipositor of female prolonged, stout and thickly chitinized, venation of wing normal. . . . . **Plastophora.**
Ovipositor fleshy and retracted as usual, first and third veins strongly approximated, legs stout. . . . **Syneura.**

11. Fourth, fifth and sixth veins light, seventh wanting; four transverse rows of frontal setæ. . . . . **Metopina.**
Fourth, fifth, sixth and seventh veins strong; three transverse rows of frontal setæ. . . . . **Puliciphora.**

12. Wings present, although of very small size. . . . 13
Wings completely absent. 16

13. Wings small, strap-shaped, often bearing long bristles. . 14
Wings larger, indistinctly veined, more or less triangular in shape. **Commoptera**, female;

14. Wings destitute of long bristles, abdomen without large macrochætæ. . . . . **Ecitomyia**, female.
Wings with very long bristles, head much wider than thorax, abdomen often with large macrochætæ. 15

15. Head transversely arcuate, abdomen bare, wing bristles very long and stout. . . . . **Acontistoptera**, female.
Head sub-triangular, abdomen with many very long macrochætæ arranged in transverse rows. . . **Xanionotum**, female.

16. Body when seen from above oval, cockroach-like. **Ænigmatias**.
Body separated into the usual three parts, ocelli present.
Puliciphora, female.

NOTE—No doubt much of interest awaits anyone who may undertake to study the varied habits of this interesting little family.

XXVIII. Family LONCHOPTERIDÆ.

Small (2-4 mm.), slender, brownish or yellowish flies. Antennæ short, third joint rounded or globular, with a terminal bristle. Ocelli present; front bristly. Legs long, bristly; pulvilli very small; empodia wanting. Wings lancet-like, pointed, the basal cells of small size and nearly equal length; fourth longitudinal vein furcate; first longitudinal vein short, second and third not furcate; the anterior cross-vein lies near the base of the wing, in front of the middle of the second basal cell, and is oblique in position.

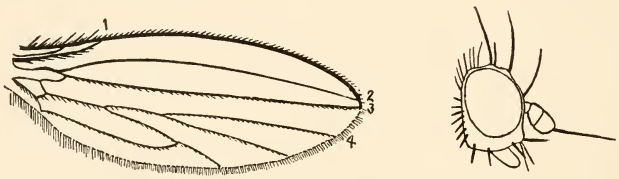


Fig. 92. *Lonchoptera*, wing and head of female.

There is but one genus in this singular family, *Lonchoptera*, the members of which may be found, often in large numbers, in the grass or upon stones along the margins of shady brooks. The larvæ live under leaves and partially decomposed vegetable matter; they are flat, with long bristles on the first, second and last segments; posterior spiracles broadly separated on the last segment, short and tubular; head not differentiated; the body composed of ten segments, the last one apparently formed of two. The larva transforms into a sort of semi-pupa within the last larval skin, and, later into a true pupa. The venation of the male differs from that of the female in the termination of the hindmost vein.

XXIX. Family PLATYPEZIDÆ.

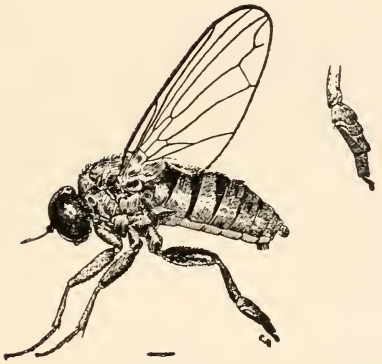


Fig. 93. *Platypeza*, species; enlarged. After Washburn.

Small, thinly pilose flies, with bristles; especially characterized by the ornamentation or enlargement of the hind tarsi. Head hemispherical, as broad or broader than the thorax, and closely applied to it. Face usually short and broad. Eyes bare, contiguous in the male, and in some species in the female also. Ocelli present. Antennæ porrect, the first two joints short, the third somewhat elongate, oval, pyriform or conical, with a terminal arista. Thorax rather stout, with distinct bristles; scutellum with bristles. Abdomen comparatively short; hypopygium more or less incurved. Legs short and strong; hind legs more or less thickened and the hind metatarsi thickened or variously ornamented in the American forms, the following joints often partaking of their peculiar structure. Wings rather large; third longitudinal vein simple, the fourth sometimes imperfectly furcate; first posterior cell always open in the margin;

basal cells small, the anal always longer than the second basal; posterior cross-vein sometimes wanting.

The flies of this small family have been seen dancing in the air in small swarms, or running about on the leaves of underbrush. The most remarkable thing about them is the oftentimes extraordinary ornamentation of the hind tarsi of the males, which are always different in structure from those of the females. The flies are not often met with, and may be entirely wanting even in considerable collections of diptera. Some, perhaps all platypezid larvæ live in fungi (*Agaricus*, *Lepiota*, etc.). They are flat, oval, with jointed, thread-like processes on the sides of the segments. The puparia are not very different from the larvæ.

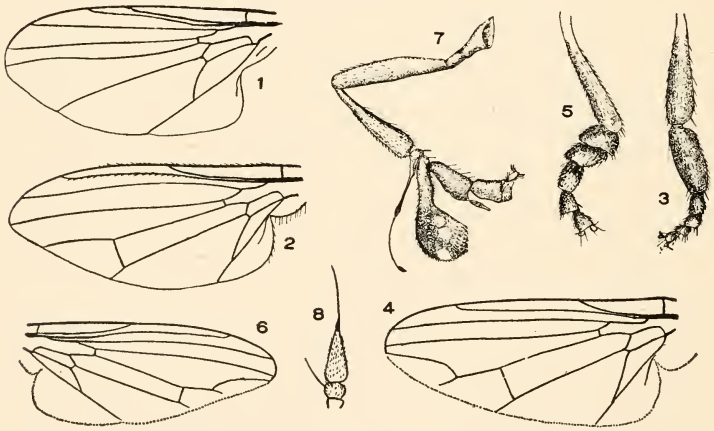


Fig. 94. Platypezidæ. 1, *Platycnema*, wing; 2, *Callimyia*, wing; 3, *Callimyia*, hind tarsus of male; 4, *Platypeza*, wing; 5, *Platypeza*, hind tarsus of male; 6, *Calotarsa*, wing; 7, *Calotarsa*, hind leg of male; 8, *Agathomyia*, antenna (Verrall).

TABLE OF GENERA.

1. Discal cell open; fourth longitudinal vein not furcate; humeral bristle conspicuous (1). . . . . ; . **Platycnema.**
   Discal cell complete. 2

2. Fourth longitudinal vein furcate. 3
   Fourth longitudinal vein not furcate. 4

3. Hind tarsi of male with ornamental appendages (6, 7) **Calotarsa.**
   Hind tarsi of male not with ornamental appendages (4, 5). **Platypeza.**

4. First longitudinal vein spinulose; third joint of antennæ rather short (2, 3). . . . . **Callimyia.**
   First longitudinal vein not spinulose; third joint of antennæ elongate conical (8). . . . . **Agathomyia.**

XXX. Family PIPUNCULIDÆ.

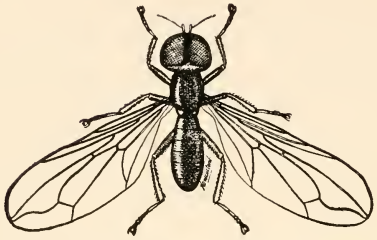


Fig. 95. *Pipunculus fuscus*, enlarged. After Lugger.

Small, thinly pilose or nearly bare flies with large heads. Head nearly spherical, broader than the thorax, composed chiefly of the large eyes. Eyes of the male approximated closely or contiguous above; separated by the narrow front in the female. Face narrow. Antennæ small, short, three-jointed, the third joint oval, reniform or aculeate, with a dorsal arista. Ocelli present. Proboscis small, concealed. Abdomen composed of six or seven segments, small, cylindrical; hypopygium thickened, more or less club-shaped; ovipositor usually elongate and folded under the abdomen. Legs simple; metatarsi elongate, tarsi broad; tibiæ without spurs; pulvilli present. Squamæ vestigial. Wings much longer than the abdomen; basal cells large, the anal cell elongate, reaching to or nearly to the margin; first posterior cell narrowed in the margin, but never closed; three posterior cells; posterior cross-vein sometimes absent.

The flies of this small family are commonly met with on flowers or in sweepings, and are readily distinguished by their large, subspherical heads. The larvæ are parasitic, so far as is known. Coheman has reared larvæ of

Pipunculus fuscipes from *Thamnotettix* (*Cicadula*) *virescens*. They are elliptical, thick, depressed, narrowed at either end, naked and small. The puparia are somewhat smaller, oval, obtuse at either end, shining pitchy black. *Chalarus spurius* is said to be parasitic on a species of *Typhlocyba*.

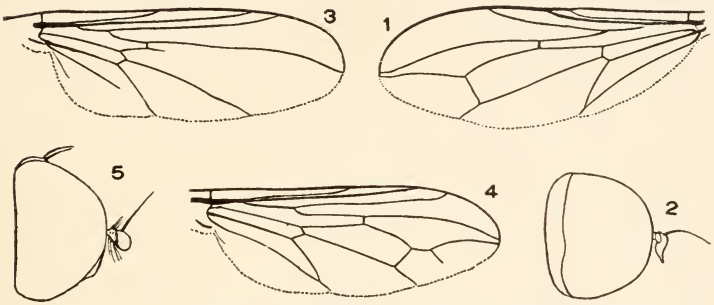


Fig. 96. Pipunculidæ. 1, *Pipunculus*, wing; 2, *Pipunculus*, head; 3, *Chalarus*, wing; 4, *Verrallia*, wing; 5, *Verrallia*, head (Verrall).

TABLE OF GENERA.

1. Posterior cross-vein absent (**3**). . . . . **Chalarus.**
   Posterior cross-vein present, the discal cell complete. . . 2
2. No ocellar bristles; occiput excavated. 3
   Ocellar bristles; occiput flattened; pilose species (**4, 5**). **Verrallia.**
3. Thorax with well developed bristles; third antennal joint reniform (**12, 13**, p. 80). . . . . **Nephrocerus.**
   Thorax not with well-developed bristles; third antennal joint more or less aculeate below; smaller species (**1, 2**). **Pipunculus.**

XXXI. Family SYRPHIDÆ.

97. *Eristatis tenax.* Enlarged one-half. After Kellogg.

Small to rather large flies. Head hemispherical, often elongated or produced in the lower part; as broad or a little broader than the thorax. Face moderately broad, bare or clothed with dust or short pile; excavated in profile under the antennæ and projecting below, or with a distinct convexity near the middle part, never with longitudinal furrows or lateral ridges, usually convex transversely, sometimes with a median ridge. Oral opening large; proboscis rarely much elongated. Front never excavated. Antennæ usually porrect and approximated at their base, three-jointed, usually with a dorsal arista. Eyes large, bare or pilose; in the male usually contiguous above. Ocelli always present. Thorax comparatively large and robust, moderately arched above. Squamæ of moderate size. Abdomen composed of five or six visible segments, rarely with only four. Hypopygium usually not prominent. Legs usually of moderate strength, never long. Bristles rarely present in any part of the body, never on the head; the body generally thinly pilose or bare, but sometimes clothed with thick pile. Wings comparatively large; third longitudinal vein never forked; marginal cell open or closed; the fourth vein terminates in the third at or before its tip; three posterior cells; basal cells large; anal cell always closed before the border of the wing; between the third and fourth longitudinal vein and nearly parallel with them, a false

or spurious vein, nearly always present and *characteristic of the family*.

The family Syrphidæ is one of the most extensive in the order. About twenty-five hundred species are known throughout the world and new forms are constantly discovered. They contain among them many of the brightest-colored flies, and numerous specimens are sure to appear in any general collection of insects. None are injurious in their habits to man's economy and many are beneficial. In their adult habits they all have a great uniformity. They are flower-flies and feed upon honey and pollen, loving the bright sunshine.

Fig. 98. *Milesia virginiensis*, enlarged.

The larvæ are usually not very elongate, with firm, sometimes tough skin, the head-segments small and extensile, the head not distinctly differentiated. The external mouth-parts are either wholly wanting, with only a soft fleshy opening, or there are two or four outwardly

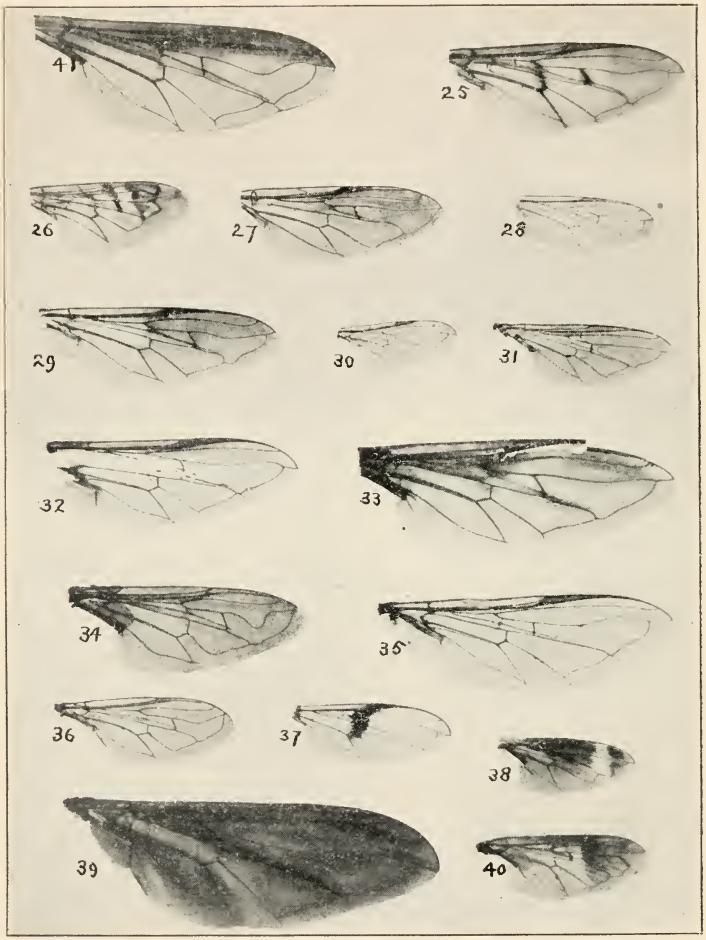
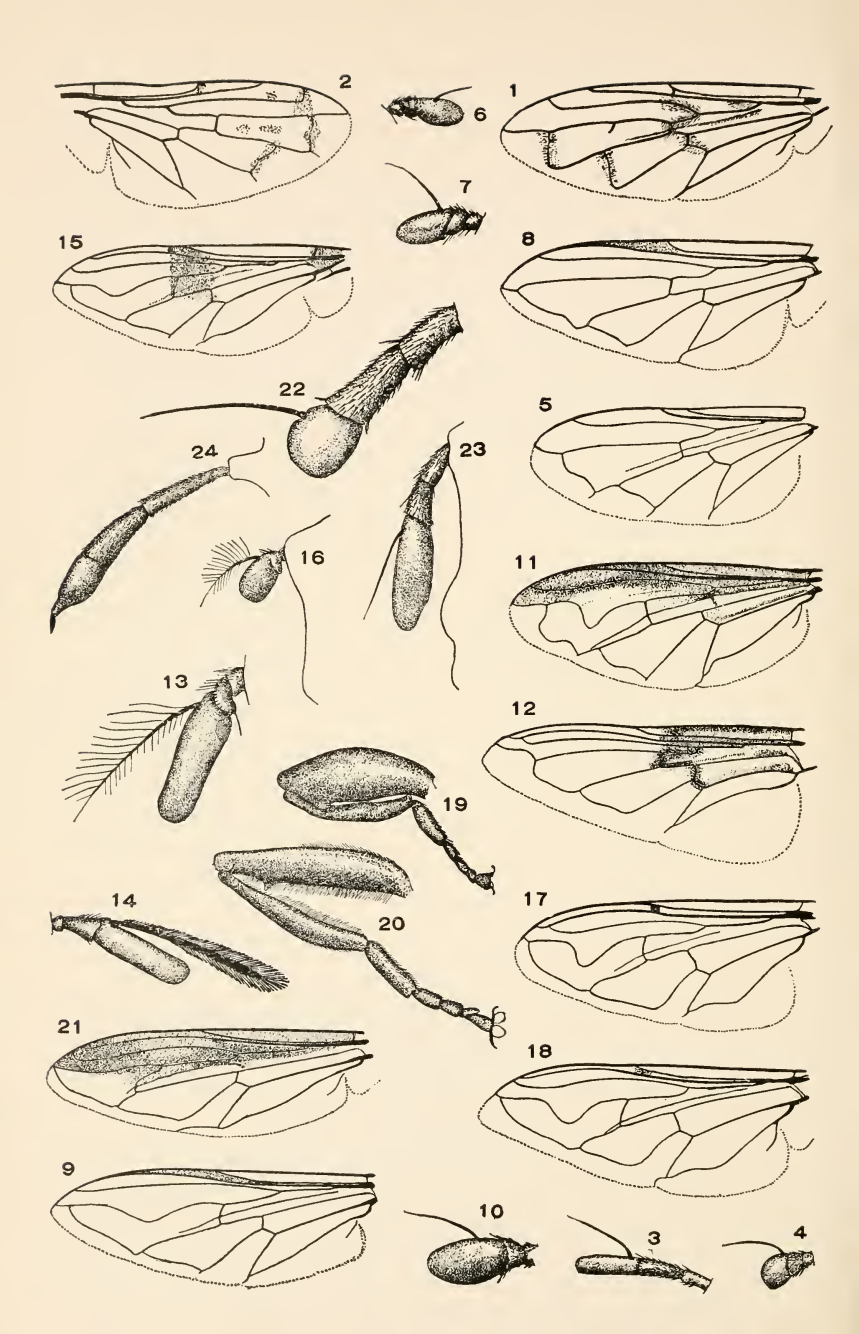


Fig. 99. Syrphidæ. See page 251.

directed hooklets. Antennæ short, small, one or two jointed and fleshy. Body smooth or provided with soft conical projections and bristles; below usually with seven pairs of abdominal feet. At the posterior end the body terminates in a more or less elongate tube, single or double, the stigmata. This tube sometimes forms a short, almost chitinized, tubercular projection on the dorsal part of the last segment; at other times it is very long, longer than the body, slender and composed of two joints, the one sliding within the other, like the joints of a telescope. In changing to the pupal condition, the larval skin contracts to form the pupal envelope, and the body becomes shorter, more oval and of a darker color, the elongated respiratory tube, in the 'rat-tailed' species, being curved over the back. Unlike most other Cyclorrhapha, the frontal lunule is not used in pushing off the cap to the puparium.

The habits of the larvæ are more variable than those of the adult flies. A large number live in decaying wood, or other vegetation, or in ordure, or decomposing animal remains. Some live in the stems of various plants, some in fungi. The larvæ of many species of *Syrphus* and allied forms are aphidophagous, crawling about on the stems of plants frequented by plant-lice, and destroying them. Some live in ants' nests and may be parasitic; others in the nests of humble bees.

Because of the large number of genera in the family, and the consequent length of the table, I give at the close an auxiliary grouping of the larger part of those genera which present decisive characters. By examining any specimen for the eleven characters given, and noting the agreement in numbers, the student may, in many cases, be more assured of his determinations. This family is a peculiarly difficult one to define clearly all the genera in a dichotomic table. I have introduced a number of cross-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references to such genera as may be doubtful to the novice. Nearly all the genera, and many of the species will be found figured in the author's Synopsis.

Several attempts have been made to subdivide the family into sub-families, but no proposed plan has received general approbation. I have recognized but three, the Syrphinæ, Eristalinæ and Cerinæ. Verrall in his late attempt at classification has introduced several others, but not always happily. I cannot approve of such associations as *Psarus*, *Callicera*, *Chrysotoxum* and *Sphecomyia* in the subfamily *Chrysotoxinæ*, distinguished chiefly by the elongate antennæ. Some species of *Sphecomyia* have very short antennæ, notwithstanding which they show the closest relationship with the typical form. The length of the antennæ is always doubtfully a generic character even, and certainly cannot be used as a distinguishing character for larger groups.

Figs. 101, 102. Syrphidæ. 1, *Microdon*, sp. wing; 2, *Chrysogaster nitida*, wing; 3, *Chrysogaster nitida*, antenna; 4 *Chrysogaster nigripes*, antenna; 5, *Paragus tibialis*, wing; 6, *Pipiza*, sp., antenna; 7, *Paragus tibialis*, antenna; 8, *Chilosia*, sp., wing (spurious vein omitted). 9, *Didea laxa*, wing; 10, *Didea laxa*, antenna; 11, *Salpingogaster*, sp., wing; 12, *Volucella*, sp., wing; 13, *Volucella*, antenna; 14, *Copestylum marginatum*, antenna; 15, *Arctophila flagrans*, wing; 16, *Sericomyia militaris*, antenna, 17, *Eristalis*, sp., wing; 18, *Helophilus similis*, wing; 19, *Tropidia quadrata*, hind leg; 20, *Milesia virginiensis*, hind leg; 21, *Spilomyia longicornis*, wing; 22, *Spilomyia longicornis*, antenna; 23, *Chrosotoxum*, species, antenna; 24, *Sphyximorpha*, sp., antenna; 25, *Ferdinandea cræsus*, wing; 26, *Volucella fasciata;* 27, *Myiolepta auricaudata;* 28, *Syritta pipiens;* 29, *Xylota pigra;* 30, *Pipiza pulchella;* 31, *Platycheirus hyperboreus;* 32, *Syrphus americanus;* 33; *Sericomyia militaris;* 34, *Pterallastes* (*Triodonta*) *curvipes;* 35, *Scæva pyrastri*; 36, *Tropidia quadrata;* 37, *Baccha lemur;* 38, *Trichophthalmomyia*, sp., 39, *Baccha*, sp.; 40, *Apophysophora*, sp.; 41, *Chrysotoxum*, species.

TABLE OF GENERA.

1. Antennæ with a terminal style. 2
   Antennæ with a dorsal (rarely subterminal) arista. . . 4
2. Antennæ cylindrical, the first two joints elongated; first posterior cell with a stump of a vein (24) (*Ceria*). **Sphyximorpha.**
   First two joints of the antennæ short. 3
3. Eyes bare; small species. . . . . **Pelecocera.**
   Eyes pilose; larger species. . . . . **Callicera.**
4. Marginal cell of the wings closed and petiolate. . . . 48
   Marginal cell open. 5
5. Anterior cross-vein of the wings distinctly before the middle of the discal cell; almost always rectangular. . . . 6
   Anterior cross-vein near or beyond the middle of the discal cell, usually oblique. 55
6. Antennæ elongate (if arista plumose, see 56). . . . 7
   Antennæ short. 14
7. Mesonotum with yellow lateral stripes; large species, the abdomen always with distinct yellow bands (23, 41). **Chrysotoxum.**
   Mesonotum not with distinct yellow lateral stripes or margins. 8
8. Face rounded, not tuberculate, pilose; oral margin not projecting. 9
   Face not evenly arched; tuberculate or the oral margin projecting. 12
9. Moderately large to large species; scutellum flattened, often with spines or tubercles on its border; a stump of a vein in the first posterior cell from the third longitudinal vein. . . 10
   Small species; scutellum without spines; no stump of vein in first posterior cell (30). . . . . **Pipiza.**
10. Abdomen much narrowed at the base. 11
    Abdomen not or but little narrowed at base (1). **Microdon.**
11. Face swollen and prominent below. . **Rhopalosyrphus.**
    Face not swollen and prominent below. . . **Mixogaster.**
12. Body clothed with sparse tomentum; all the femora thickened and with spinous bristles below (*Lepromyia**). **Lepidostola.**
    Body not clothed with flattened tomentum; the femora not thickened with spinous bristles below. 13
13. Face partly or wholly yellow, tuberculate below, the epistoma not projecting; face and front not wrinkled (5, 7). **Paragus.**

* The name *Lepidostola* Mik has slight priority over *Lepromyia*.

Front and face wholly black in ground color (*Chrysogaster*, *Rhysops*). 19

14. Face black in ground color. 15
Face more or less yellow or yellowish in ground-color. . 26

15. Abdomen with only four visible segments, very convex, the venter excavated; first two joints of the antennæ very short, the third large, subquadrate, with a short subterminal arista. **Nausigaster.**
Abdomen with more than four visible segments. . . . 16

16. Hind femora distinctly thickened. 17
Hind femora but little or not at all thickened. . . . 18

17. Scutellum unusually large, nearly square; males dichoptic. **Chalcomyia.**
Scutellum not unusually large, considerably broader at its base; males holoptic and with a facial tubercle (27). **Myiolepta.**

18. Face rounded, not tuberculate, the oral margin not projecting (30) **Pipiza.**
Face tuberculate or the oral margin projecting. . . . 19

19. Epistoma projecting; small, black species. 20
Face tuberculate, the oral margin not projecting. . . . 21

20. Front in the female and usually the face in both sexes with transverse wrinkles; spurious vein obsolete; antennæ short or long (2, 3, 4). . . . . **Chrysogaster.**
Front and face not wrinkled; face pilose. . . . **Psilota.**

21. Metallic green, metallic green and black, or black species; facial orbits separated by a slender parallel groove (8). **Chilosia.**
Black with more or less metallic green or blue, with yellow, yellowish or metallic cross-bands on the abdomen; face not with orbital grooves. 22

22. Face with transverse grooves in the middle; (antennæ elongate). **Rhysops.***
Face not with transverse grooves or wrinkles. . . . 23

23. Wings not longer than the abdomen; ocellar tubercle large; abdomen depressed, long elliptical, somewhat narrowed toward its base, the markings ferruginous or orange yellow. **Pyrophæna.**

* *Melanostoma scitulum*, *rugonasus*, *melanocerum*.

Wings longer than the abdomen, abdomen with yellow or greenish-yellow, or shining metallic cross-bands; usually elongate species. 24

24. Front tibiæ distally and the tarsi of the male dilated, those of the female slightly widened (31). . . . **Platycheirus.**
Front tibiæ and tarsi slender in both sexes. 25

25. Rather large, blackish species, with a large flat, elliptical abdomen. . . . . **Xanthandrus** Verrall.*
More elongate and slender species; abdomen not elliptical in outline. . . . . **Melanostoma.**

26. Abdomen narrowed toward the base, distinctly club-shaped or spatulate in outline. 27
Abdomen oval or slender, not spatulate or club-shaped in outline. 30

27. Third longitudinal vein bent deeply into the first posterior cell. (11) **Salpingogaster.**
Third longitudinal vein straight or gently curved. . . 28

28. Hind femora slender; front of female long, narrowed above; the cheeks very narrow below the eyes; abdomen often very slender. (37, 39). . . . . **Baccha.**
Hind femora thickened; front not unusually long in female. 29

29. Epistoma produced anteriorly, the face in profile deeply concave from antennæ to tip; third joint of antennæ rounded. **Sphegina.**
Epistoma produced more downward, in profile gently concave; third joint of antennæ not rounded. . . . **Neoascia.**

30. Front long, much narrowed above in the female; cheeks very narrow, the eyes approaching each other at the lower third of the head; wings usually with dark picture; abdomen more or less elongate (compare *Baccha* when in doubt as to shape of abdomen). . . . . **Ocyptamus.**
Flies not having the above assemblage of characters. . . 31

31. Mesonotum with distinct yellow lateral margins. . . . 38
Mesonotum not with yellow lateral margins. . . . 32

32. Abdomen with definite yellow cross-bands. 33
Abdomen not with definite yellow cross-bands. . . . 42

* *Melanostoma bucephalus* Wied.

33. Hind femora extraordinarily thickened (28). . . **Syritta.**
Hind femora slender. 34

34. Sixth abdominal segment in the male as long as the two preceding together, cylindrical; fifth segment of the female one-half as long as the preceding. . . . . **Eupeodes.**
Sixth abdominal segment of the male not peculiar; the fifth segment of the female one-third or one-fourth as long as the preceding. 35

35. Front very convex; eyes of male with an area of enlarged facets above (*Lasiopticus* (35). . . . . **Scæva.***
Front not remarkably convex. 36

36. Third longitudinal vein with distinct curvature into the first posterior cell; third joint of antennæ elongate oval (9, 10). **Didea**
Third longitudinal vein straight or gently curved; epistoma not produced (if produced snout-like, *Rhingia*). . . . 37

37. Males holoptic (32). . . . . **Syrphus.**
Males broadly dichoptic; arista more or less thickened.
Chamæsyrphus.

38. Mesonotum with median cinereous line; ocelli usually remote from the vertex. 39
Mesonotum not with a median cinereous linear stripe. . 40

39. Hind femora in the male thickened and arcuate, the tibiæ dilated at the tip. . . . . **Toxomerus.**
Hind femora simple and straight; the tibiæ not dilated at tip.
Mesogramma.

40. Eyes of male with an area of enlarged facets above; fourth segment of abdomen with two median yellow stripes and oblique side spots. . . . . **Allograpta.***
Eyes of male not with an area of enlarged facets above; fourth abdominal segment not so marked. 41

41. Face projecting below; slender species, the hypopygium often large. . . . . **Sphærophoria.**
Face receding; abdomen oval. . . . **Xanthogramma.**

42. Thickly pilose species; the abdomen black, the basal part light yellow. . . . . **Leucozona.**
Thinly pilose species; abdomen not so marked. . . . 43

43. Hind femora thickened. 44
Hind femora slender. 47

* Feebly characterized genera.

44. Species wholly or chiefly reddish or lutescent. . . . 46
Black species, sometimes with luteous spots on face, humeri and basal angles of abdomen. 45

45. Scutellum unusually large, nearly square in outline; males dichoptic. . . . . **Chalcomyia.**
Scutellum oval; males holoptic (27). . . . **Myiolepta.**

46. Face carinate; abdomen oval. . . . . **Brachyopa.**
Face tuberculate; abdomen more elongate. **Hammerschmidtia.**

47. Epistoma produced into a long porrect snout. . . **Rhingia.**
Epistoma not produced (compare *Paragus* sp. if small); facial orbits limited by a slender groove (8). . . . **Chilosia.**

———o———

48. Third vein bent deeply into the first posterior cell. . . 51
Third vein not bent deeply into first posterior cell; third antennal joint elongate. 49

49. Arista very densely plumose, appearing as a solid mass, the arista itself also thickened (14). . . . . **Copestylum.**
Arista feathery plumose. 50

50. Hairs of arista retrorse; males dichoptic. . **Megametapon.**
Hairs of arista not retrorse; males holoptic (12, 13, 36). **Volucella.**

51. Hind femora with a sharp tooth-like projection below near distal end; sixth vein beyond anal cell strongly curved; large species (20). . . . . **Milesia.**
Hind femora without such tooth. 52

52. Frontal triangle of male strongly protuberant; rather large, dark-colored species (*Priomerus, Doliosyrphus.*) . **Eristalis.**
Frontal triangle not protuberant. 53

53. Epistoma produced into a long porrect snout. **Licastrirhyncha.**
Epistoma not produced. 54

54. Thorax with distinct yellow markings; hind femora thickened; hypopygium enlarged. . . . . **Meromacrus.**
Thorax not with distinct yellow markings, sometimes white-fasciate; femora sometimes thickened; hypopygium not conspicuously prominent (17). . . . . **Eristalis.**

———o———

55. Arista plumose. 56
Arista bare or pubescent. 60

56. Antennæ elongate, the third joint more than twice as long as wide (*Phalacromyia*, *Glaurotricha*). . . . **Volucella.**
Antennæ short, the third joint not more than twice as long as wide; third vein nearly straight, or gently or considerably curved into first posterior cell. 57

57. Thinly pilose; abdomen with yellow bands. . . . 58
Thickly pilose; abdomen not with yellow bands. . . . 59

58. Third vein straight or moderately curved. . . **Sericomyia.**
Third vein considerably curved.* . . . **Condidea** Coq.

59. Eyes pubescent† . . . . . **Pyritis.**
Eyes bare (**15**). . . . . **Arctophila.**

60. Third longitudinal vein deeply curved into the first posterior cell. 61
Third vein only gently curved. 70

61. Hind femora thickened. 63
Hind femora slender. 62

62. Abdomen elongate, narrowed at base, spatulate in outline (**11**). **Salpingogaster.**
Abdomen oval, with yellow, interrupted bands; mesonotum with yellow margins; antennæ elongate (**22, 41**). **Chrysotoxum.**

63. Face carinate or subcarinate; hind femora with an angular protuberance or spur below at outer end:
Face protuberant in profile (**19, 36**) . . **Tropidia.**
Face concave in profile, subcarinate; spur of femora bifid. **Senogaster.**
Face tuberculate or arched, not keeled. 64

64. Abdomen much narrowed at base, club-shaped. **Ceriogaster.**
Abdomen not at all pedunculate or basally narrowed. . 65

65. Antennæ elongate; eyes pubescent; wings colored anteriorly. **"Platynochætus"** *niger*. ♀‡
Antennæ not elongate. 66

* This character is found in some of the species of *Arctophila*, *Tropidia*, etc., but is not considered generic.

† Ocular pubescence alone is not of generic value; I do not know the genus.

‡ This is perhaps not a true *Platynochætus*. The terminal expansion of the arista is a male character. I do not know it.

66. Third joint of antennæ broad; mesonotum not vittate. . 68
Third joint of antennæ oval.
Males holoptic; femora with protuberance below. **Merodon.**
Males dichoptic; femora not with protuberance. . . 67

67. Ocelli remote from each other; mesonotum not vittate.
Asemosyrphus.
Ocelli not remote from each other; mesonotum vittate (18).
Helophilus.

68. Thickly pilose species. . . . . **Mallota.**
Thinly pilose. 69

69. Hind tibiæ of male with an internal spur (compare *Mallota*, sp.)
Teuchocnemis.*
Hind tibiæ of male not with such spur (*Triodonta*, *Polydonta*) (34). . . . . **Pterallastes.**

70. Thorax with distinct yellow markings other than on the humeri; wasp-like flies. 81
Thorax not with distinct yellow markings of the ground-color other than rarely on the humeri. 71

71. Hind femora swollen and with a protuberance or spur below distally; face carinate or subcarinate. 72
Hind femora not with such protuberance or spur. . . 73

72. Face concave in profile; femoral spur bifid. **Senogaster.**†
Face protuberant in profile; femoral protuberance not spur-like (19, 36). . . . . **Tropidia.**

73. Abdomen narrowed basally; slender species (see 27).
Abdomen in no wise club-shaped. 74

74. Face transversely arched, not produced, not tuberculate; abdomen more or less elongate and nearly bare. . . . 75
More or less thickly pilose species; often large. . . . 76

75. Hind femora extraordinarily thickened; anterior cross-vein rectangular, and before the middle of discal cell (*Syritta*).
Hind femora distinctly thickened, but the cross-vein distinctly oblique, and near or beyond middle of discal cell. **Xylota.**‡

* Of doubtful validity; I think that both this and *Polydonta* should be united with *Pterallastes*.

† Of doubtful occurrence in the United States.

‡ *Xylota* may be confounded with *Brachypalpus*. The nearly bare abdomen of the one, rather thickly pilose of the other, will distinguish them.

76. Scutellum, margin of thorax and pleuræ with distinct bristles, femora slender (*Chrysochlamys*) (25). . **Ferdinandea.**
No bristles anywhere on body. 77

77. Face short, not produced, concave from antennæ to oral margin, not tuberculate; hind femora thickened. 78
Face produced, long. 79

78. Abdomen elongate. . . . . **Brachypalpus.**
Abdomen very broad; thorax densely pilose; middle femora of male sometimes (*Hadromyia*) with a stout, basal, inferior spur. **Pocota.**

79. Face produced forward, pointed, concave from antennæ to tip, not tuberculate; hind femora thickened. . . **Crioprora.***
Face not evenly concave in profile, but tuberculate or convex. 80

80. Third joint of antennæ produced above into an anteriorly directed, conical process, terminating in the thickened arista. **Merapioidus.**
Third joint of antennæ obliquely oval; hind femora rarely thickened. . . . . **Criorhina.**

81. Hind femora with a conical, tooth-like protuberance below near distal end; antennæ more or less elongated; sixth vein directed obliquely outward beyond anal cell (21, 22). **Spilomyia.**
Hind femora without much protuberance; sixth vein beyond anal cell not unusual. 82

82. Antennæ inserted low down, near middle of head in profile, the face not longer than front. . . . . **Temnostoma.**
Antennæ inserted on a conical process; front short, the face much produced downward; antennæ long or short. **Sphecomyia.**

AUXILIARY TABLE.

1. Marginal cell of wings closed:
Copestylum, 4, 5, 8.
Eristalis 2, (5), 8.
Lycastrirhyncha, 2, 6.
Megametapon 4, 5, 8, 10.
Meromacrus, 2.
Milesia, 2, 7.
(Priomerus), 2, 8.
Voluceila, 4, 5, 8.

2. Third longitudinal vein markedly curved into first posterior cell.
Asemosyrphus, 10.
Ceriogaster, 9.
Chrysotoxum, 4, 8.
Condidea, 5.
Didea, 8, (fig. 17).
Eristalis, 1. 5, 8; (fig. 17).
Helophilus, 10, (fig. 18).
Lycastrirhyncha, 1, 6.
Mallota, 8, 10.
Meromacrus, 1.
Arctophila, sp. 5, (fig. 15).
Platynochætus, 13.
(Priomerus), 1, 8.
Pterallastes, 4.
Salpingogaster, 9, (fig. 11).
Syrphus, sp.
Teuchocnemis.
Tropidia, 7.
Milesia, 1, 7.

* *C. arctophiloides* is a *Criorhina*,

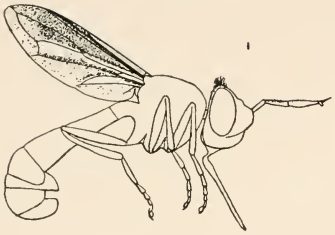
3. First posterior cell with a stump of vein from the third longitudinal vein:
   Sphyximorpha, 4, 11.
   Microdon, 4, 8, (fig. 1).
   Mixogaster, 4, 9.
   Rhopalosyrphus, 4, 8, 9, 10.
4. Antennæ elongate:
   Sphyximorpha, 3, 11, (fig. 24).
   Chrysogaster, spp. (fig. 3).
   Chrysotoxum, 2, 8, (fig. 4).
   Copestylum, 1, 5, 9, (fig. 14).
   Lepidostola,
   Megametapon, 5, 10.
   Microdon, 3, 8.
   Mixogaster, 3, 9.
   Paragus, spp. 8.
   Pipiza, 8.
   Platynochaetus, 2.
   (Phalacromyia), 5.
   Rhopalosyrphus, 3, 8, 9, 10.
   Rhysops.
   Sphecomyia, sp.
   Spilomyia spp. 7, (fig. 23).
   Volucella, 1, 5, 8.
5. Arista plumose:
   Arctophila, 2.
   Brachyopa, spp.
   Chilosia, spp. 8.
   Copestylum, 1, 4, 8, (fig. 14).
   Eristalis, spp. 1, 2 (8).
   Megametapon, 4, 8, 10.
   Condidea, 2.
   Pyritis,
   Sericomyia (fig. 16).
   Volucella, 1, 4, 8, (fig. 13.)
6. Epistoma produced into a long, porrect snout:
   Rhingia,
   Lycastrirhyncha, 1, 2.
7. Hind femora with a projection below:
   Milesia, 1, 2.
   Pterallastes, 2, (sp.) 7.
   Senogaster, 2, 9.
   Spilomyia, 4.
   Tropidia, 2.
8. Eyes pubescent:
   Chilosia, spp.
   Chrysotoxum, 4.
   Ferdinandea.
   Copestylum, 1, 4, 5.
   Didea, sp. 2.
   Eristalis, spp. 1, 2, 5.
   Leucozona.
   Mallota, 2, 10, (sp).
   Megametapon, 1, 4, 5, 10.
   Microdon, spp. 3, 4, 10.
   Paragus, 4.
   Pipiza, 4.
   Psilota.
   Pyritis, 5.
   Rhopalosyrphus, 3, 4, 9, 10.
   Scæva.
   Syrphus, spp.
   Volucella, 1, 4, 5; or 4, 5.
9. Abdomen spatulate or conspicuously narrowed at base:
   Baccha.
   Ceriogaster, 2.
   Mixogaster, 3, 4, 8, 10.
   Neoascia.
   Rhopalosyrphus, 3, 4, 8, 10.
   Salpingogaster, 2.
   Sphegina.
   Sphyximorpha, 3, 4, 11.
10. Males dichoptic:
   Asemosyrphus, 2.
   Chalcomyia.
   Chamæsyrphus.
   Helophilus, 2.
   Mallota, sp. 2, 8.
   Microdon, 3, 4, 8.
   Mixogaster, 3, 4, 9.
   Megametapon, 1, 4, 5, 8.
   Pelecocera, 11.
   Rhopalosyrphus, 3, 4, 8, 9.
   Pterallastes, 2, 7, (sp.)
11. Arista or style of antennæ terminal:
   Callicera.
   Pelecocera, 10.
   Merapioidus.
   Sphyximorpha, 3, 4, 9.

XXXII. Family CONOPIDÆ.

Thinly pilose or nearly bare, more or less elongate flies, of moderate size. Head broad; front broad in both sexes; ocelli present or absent. Antennæ porrect, the simple third joint with a dorsal arista or terminal style. Oral opening large; proboscis elongate and slender. Abdomen often constricted toward the base; genitalia usually conspicuous. Basal cells of wing usually large, the anal closed; three posterior cells, the first closed or much narrowed; no spurious vein. An inflatable ptilinum above the antennæ.

The members of this small family are all flower-flies, not of quick flight. Some have a remarkable resemblance to wasps, doubtless protective (see fig. 3, page 18). The genus *Stylogaster* is remarkable for the very long ovipositor of the female and the elongate proboscis of both sexes; the four or five known species are from Africa, North and South America. The genus departs rather from the conopid type, with no essential differences from the Acalypteræ.

Some, perhaps all, of the larvæ of this family are parasitic upon adult hymenoptera (wasps and bees) and orthoptera. The eggs are deposited by the female, in some cases at least, directly upon the bodies of the bees or wasps during flight. The newly hatched larvæ burrow within the abdominal cavity of their host, and there remain, the hind end directed toward the base of the abdomen, consuming the less vital parts, until ready for transformation into the adults, when they escape from between the abdominal rings of the insect. The larvæ of the Conopinæ are oval or pyriform, with distinctly differentiated segments, which may be extended or con-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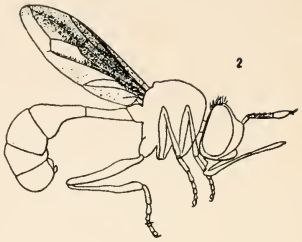
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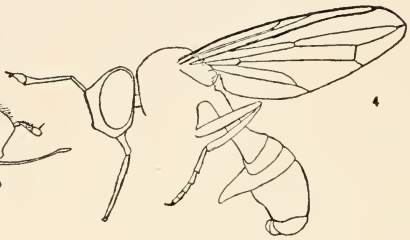
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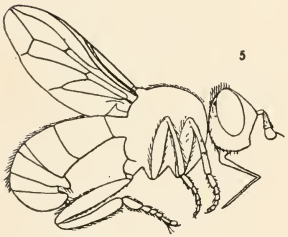
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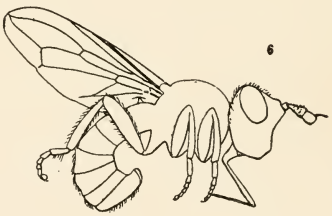
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8

7

tracted. The antennæ are wart-like, with a chitinous, ocellus-like ring on the extremity of each. The mouth-hooklets are strongly bent. On the last segment there are two large, round or reniform, stigmatic plates, arched like a watch crystal. The puparium is oval, with button-like, slightly projecting, anterior stigmata, the posterior pair as in the larvæ; it remains within the body of the host during the winter.

TABLE OF GENERA.

1. Antennæ with a terminal style; proboscis directed forward without median hinge; abdomen constricted toward the base. . 2
   Antennæ with a dorsal or subdorsal arista. 4
2. Face with a median keel, without lateral grooves; a minute ocelligerous tubercle, the ocelli vestigial (4). . **Tropidomyia.**
   Face with well-marked divergent grooves. 3
3. Femora and tibiæ not thickened or dilated, or, if so, the thickening is regular; anterior cross-vein nearly opposite or before the tip of the auxiliary vein, and near the middle of the discal cell; ocelli functional or vestigial (1). . . . . **Conops.**
   Femora irregularly thickened toward the base, the tibiæ with irregular outlines; anterior cross-vein near outer third of discal cell; ocelli vestigial (2). . . . . **Physocephala.**
4. Proboscis directed forward, not hinged backward. (3). **Zodion.**
   Proboscis bent near middle, the distal part folding back. . 5
5. Vertex with bristles; tibiæ spurred; face carinate, not grooved; ovipositor of female very long; anal cell small (8). **Stylogaster.**
   Vertex and tibiæ without bristles; face with diverging grooves. 6
6. Anal cell short; ovipositor elongate and folded beneath abdomen. (7) . . . . . **Dalmannia.**
   Anal cell elongate, acute; ovipositor not folding beneath abdomen. 7
7. Cheeks narrower than vertical diameter of eyes. . . . 8
   Cheeks as broad or broader than eyes (6). . . **Myopa.**
8. Antennæ longer than the front (5). . . . **Occemyia.**
   Antennæ shorter than the front. . . . . **Sicus.**

Fig. 101. Conopidæ. 1, *Conops xanthopareus*, female; 2, *Physocephala furcillata*, male; 3, *Zodion fulvifrons*, female; 4, *Tropidomyia bimaculata;* 5, *Occemyia modesta*, female; 6, *Myopa clausa*, female; 7, *Dalmannia picta*, female; 8, *Stylogaster neglecta*, female.

XXXIII, XXXIV. Families MICROPEZIDÆ, TANYPEZIDÆ.

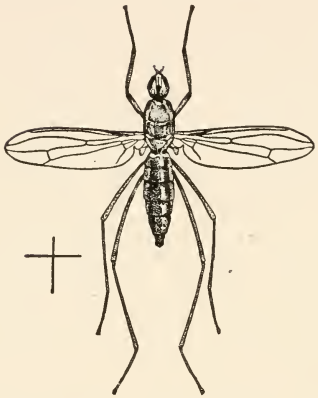


Fig. 102. *Calobata univittata*, enlarged. After Washburn.

These two groups, often associated together, present such important structural differences, and the resemblance of the insects composing them is so slight, that their separation seems entirely proper.

Tanypezidæ. Head broad, subhemispherical, the occiput concave, the eyes very large, the posterior orbits very narrow, the cheeks also narrow; front rather narrow, with bristles on upper half only. No vibrissal bristle. Antennæ more or less elongated, decumbent. Venation complete; posterior basal cells small; first posterior cell narrowed in the margin. Legs long; tarsi longer than the tibiæ; tibiæ without preapical bristle.

A single genus *Tanypeza*, with a half dozen species perhaps, is all that can be definitely referred to this group. It will be readily recognized from the accompa-

nying figures (9, 10). A second genus, *Tetradiscus* Bigot, may possibly belong here, though it has the first posterior cell open and the third joint of the antennæ rounded. The genus, if not identical with some other already known, can not be located until specimens are studied by some competent dipterist.

Micropezidæ. Head subsperical; front rather broad, not bristly on the lower part. Eyes relatively small, the orbits and cheeks moderately broad. No oral vibrissæ; face retreating in profile, sometimes very much so. Thorax narrowed anteriorly. Antennæ short or moderately elongated, porrect. Abdomen elongate; male genitalia often large and complicated. Wings elongated; auxiliary distinct in its whole course; or so closely applied to the short first longitudinal vein as to be distinguishable with difficulty. Anal cell always present, short, or drawn out into an acute point; second basal cell sometimes confluent with the discal cell; first posterior cell closed or much narrowed in the margin. Legs long and slender, the tarsi shorter than the tibiæ; no preapical tibial bristle.

So far as the known European and North American genera are concerned, the above diagnosis clearly defines the limits of the group. There are numerous forms in South America, however, which seem to break down the limits on the one hand from the Piophilidæ, on the other from the Ortalididæ. The narrowing or closure of the first posterior cell is very distinctive of our species, but is not a group character. Nor are the slender legs a real 'family' character, since there are southern forms with thickened hind femora and shorter legs which insensibly connect the more typical *Calobatæ* or *Micropezæ*, through *Cardiacephala*, with the Ortalididæ. The group is distinctively a South American one. The writer has more than a score of species in his collection from Brazil.

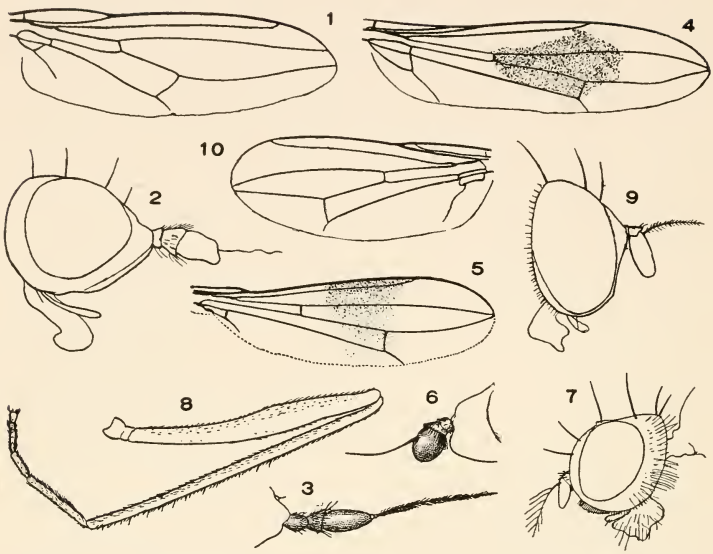


Fig. 103. Micropezidæ, Tanypezidæ. 1, *Nerius bistriatus*, wing; 2, *Nerius*, head; 3, *Telostylus*, antenna; 4, *Calobata mellea*, wing; 5, *Micropeza*, wing; 6, *Micropeza* antenna; 7, *Cardiacephala*, head; 8, *Cardiacephala*, hind leg; 9, *Tanypeza claripennis*, head; 10, *Tanypeza*, wing.

TABLE OF GENERA.

1. Second basal cell confluent with the discal cell (5, 6). **Micropeza.**
   Second basal cell complete. 2

2. Third antennal joint truncate at the tip, with a terminal bristle (1, 2). . . . . **Nerius.**
   Third antennal joint tapering to a point, into which is inserted the apical, pubescent arista (3). . **Telostylus** Bigot.
   Arista distinctly dorsal, that is nearer the base of the third joint than its tip; wings usually with markings. . . . 3

3. Auxiliary vein distinct; femora simple (4). . . **Calobata.**
   Auxiliary vein indistinguishable; posterior femora with a swelling beyond the middle (7, 8). . . . . **Cardiacephala.**

XXXV. Family PSILIDÆ.

Front bristly on the upper part; broad. Face perpendicular or somewhat retreating in profile, without vibrissæ. Antennæ moderately or very long, decumbent. Abdomen rather slender; male genitalia but little prominent, the ovipositor usually elongate. Wings large; auxiliary vein absent or indistinct; third and fourth longitudinal veins parallel; all three basal cells distinct. Legs elongate: no preapical bristle on the tibiæ.

The flies of this family are of moderate size and elongate. The larvæ of those few species in which they are known live in the roots or galls of different plants. The larvæ of *Psila* are slender, cylindrical, pale yellow, bare; the posterior stigmata are small, rounded or button-like processes of a black color.

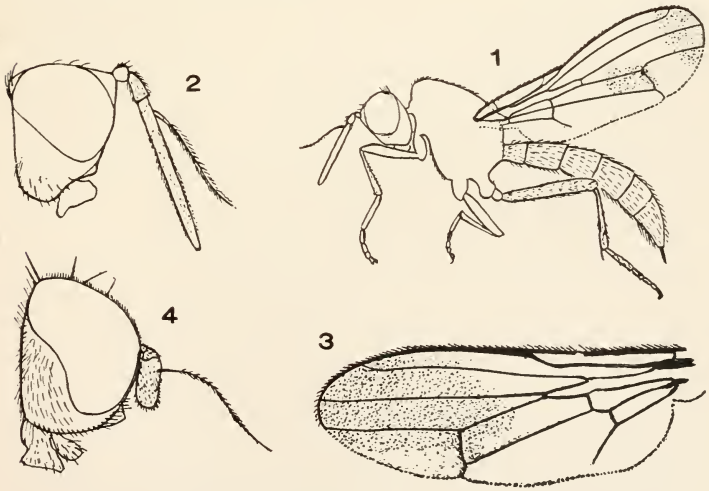


Fig. 104. 1, *Loxocera;* 2, *Loxocera*, head; 3, *Chyliza*, wing; 4, *Chyliza*, head.

The occurrence of *Megamerina* Rondani in America lacks confirmation. It has the auxiliary very distinct and probably belongs more properly with the Sepsidæ.

TABLE OF GENERA.

1. Antennæ much elongated, the third joint slender (1, 2). **Loxocera.**
   Antennæ shorter than the face, the third joint oval or rounded. 2
2. Face nearly perpendicular in profile; anal cell noticeably shorter than the second basal cell (3, 4). . . . **Chyliza.**
   Face retreating in profile; anal cell as long or longer than the second basal cell. . . . . **Psila.**

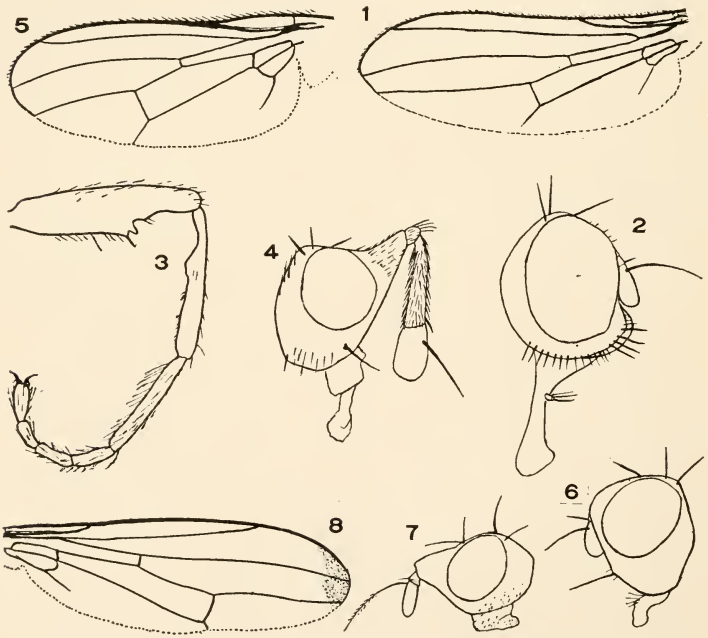


Fig. 105. Sepsidæ. 1, *Sepsis*, wing; 2, *Sepsis*, head; 3, *Sepsis*, front leg; 4, *Prochyliza*, head; 5, *Piophila*, wing; 6, *Piophila*, head; 7 *Michogaster*, head (S. A.); 8, *Michogaster*, wing.

XXXVI. Family SEPSIDÆ.

Fig. 106. *Piophila casei*, enlarged. After Washburn.

Head rounded; front bristly above; face perpendicular or a little retreating; border of the mouth more or less hairy, with or without vibrissæ; proboscis short; antennæ not porrect, usually short. Abdomen usually noticeably narrowed at the base; hypopygium prominent. Auxiliary vein distinct or more or less coalescent with the first vein; all the basal cells distinct. Middle tibiæ with spurs; tibiæ usually without preapical bristle.

The flies of this family are usually small, black and elongated, with the abdomen narrowed at the base, thickened and curved downward toward the extremity; with transparent, irridescent wing, usually hyaline, but often with a spot or spots toward the end, and are usually observed about decaying vegetables, excrement, cheese, ham, etc., often in swarms. The flies for the greater part, run about actively and are quick in flight. The best known are the species of *Piophila*, the larvæ of which are

so well known as 'cheese-mites'. These larvæ live in cheese, in ham or bacon, or in general in any fatty material, and often do much damage, being especially troublesome in pork-packing establishments. From the peculiar power of leaping possessed by the maggots they are often called 'skippers'; the act is performed by the larva seizing with its extended mouth-hooklets the edge of the posterior truncature of the body and then suddenly releasing it while pulling hard. The larvæ are somewhat conical, pointed anteriorly, truncated behind, and about five millimeters in length. They are shining and smooth; the antennæ composed of two equally long joints; the mouth hooklets separated, short and divergent; the anterior spiracles whitish, the abdominal legs roughened, the anal segment with four fleshy protuberances. Puparium elliptic, rugose.

TABLE OF GENERA.

1. Head depressed; antennæ elongate. 2
   Head not depressed; antennæ not reaching beyond the oral margin. 3

2. Second joint of antennæ elongate, the third oval (4). **Prochyliza.**
   Second joint of antennæ short, the third elongate. **Tylomyia.**

3. Auxiliary vein distinct; palpi vestigial. 4
   Auxiliary vein indistinct, or wanting. 6

4. Abdomen curved, narrowed at base, the second segment swollen. 5
   Abdomen straight or but slightly curved, but little narrowed at base, the second segment not swollen. . . **Themira.**

5. Front femora of male with tubercles on under side (1, 2, 3). **Sepsis.**
   Front femora of male not with tubercles on under side. **Nemopoda.**

6. Wings with blackish spot at tip; antennæ reaching nearly to the oral margin. . . . . **Mycetaulus.**
   Wings wholly hyaline; antennæ shorter (5, 6). . **Piophila.**

XXXVII. Family ORTALIDIDÆ.

Fig. 107. *Antineura*, sp. Brazil. Enlarged.

Rather small to moderately large flies. Front broad in both sexes, never with lower fronto-orbital bristles. Vibrissæ wanting. Clypeus distinct, usually well developed; proboscis more or less stout; palpi broad, seldom narrow. Abdomen with five segments in the male, six in the female, the first two in both sexes more or less coalescent; male with a rolled up, long penis; female with a three-jointed, horny ovipositor. Legs usually stout and short, never very slender. Venation of wings complete; auxiliary vein usually completely separated

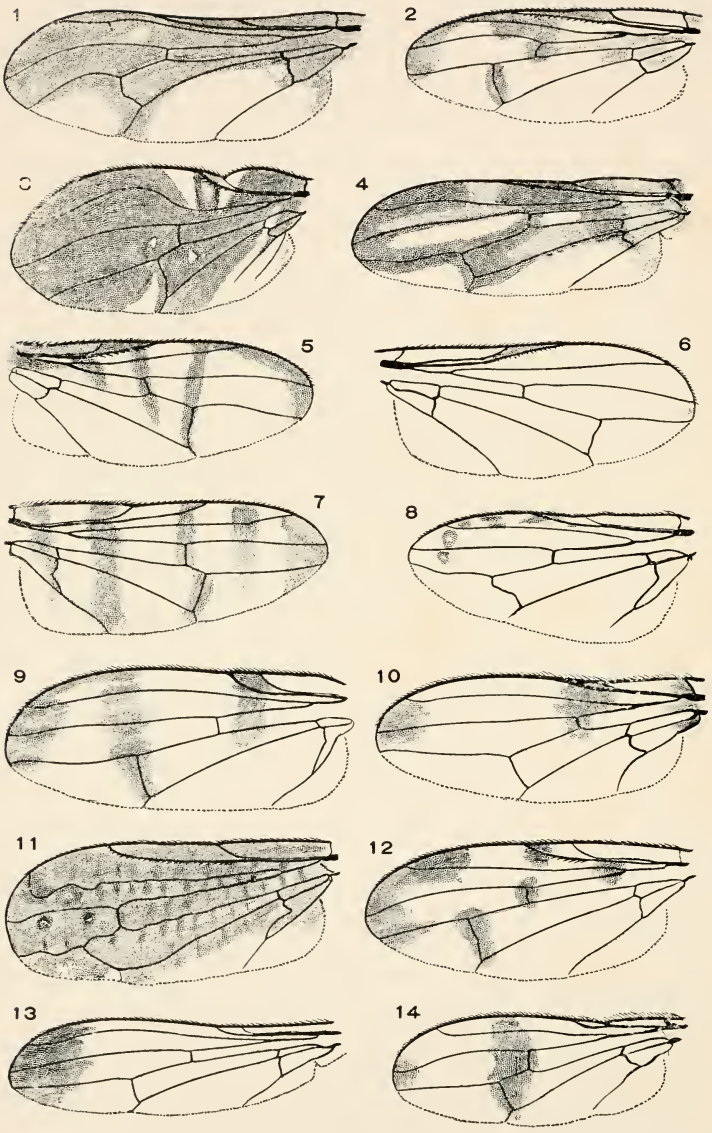
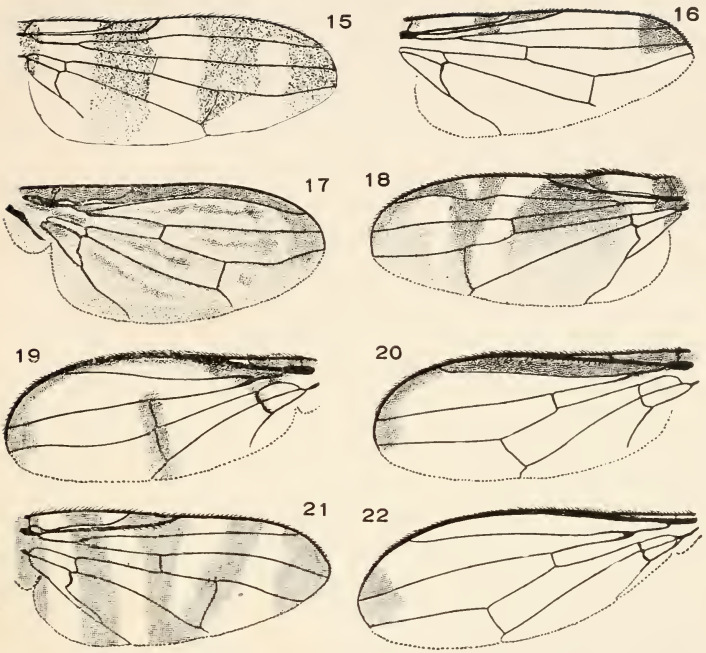


Fig. 108.



Figs. 108, 109. Ortalididæ. 1, *Pyrgota;* 2, *Stenopterina;* 3, *Camptoneura;* 4, *Idana;* 5, *Rivellia;* 6, *Tetanops;* 7, *Pseudotephritis;* 8; *Oedopa;* 9, *Chætopsis;* 10, *Cœlometopia;* 11, *Pterocalla;* 12, *Melieria;* 13, *Eumetopia;* 14, *Richardia;* 15, *Euxesta;* 16, *Euxesta;* 17, *Notogramma;* 18, *Euphara;* 19, *Antineura;* 20, *Gen. nov?* 21, *Apospasmica;* 22, *Stenomacra.*

from the first longitudinal vein, though often much approximated to it; it runs into the costa at a more or less acute angle, without becoming indistinct at its end; posterior basal and anal cells of moderate size, the latter exceptionally indistinct. Middle tibiæ alone provided with spurs; tibiæ rarely with an erect bristle before the tip exteriorly (*Automola*).

The present family includes a large number of species of flies that are sure to be represented in every collection

of diptera. Many of the species have the wings prettily marked. The family by some entomologists is divided into several independent groups, as the Doryceridæ or Pyrgotidæ, the Platystomidæ, Ulidiidæ, etc. The flies are usually found about meadows or among luxuriantly growing grass. The larvæ are but poorly known.

TABLE OF GENERA.

BY PROF. W. A. SNOW; REVISED.

1. First longitudinal vein beset with small bristles. 2
   First longitudinal vein bare. 5

2. Ovipositor flattened; ocelli present. 3
   Ovipositor not flattened; no ocelli. . . . . **Pyrgotinæ.**

3. Third antennal joint round or short ovate; ends of auxiliary and first longitudinal veins widely separated. . **Pterocallinæ.**
   Third antennal joint not round or short ovate.* 4

4. Neither pro-pleural nor meso-pleural bristles present; third antennal joint elongate. . . . . **Platystominæ.**
   A meso-pleural but no pro-pleural bristle present. **Cephalinæ.**
   Both a meso-pleural and a pro-pleural bristle present. **Ortalinæ.**

5. Posterior angle of anal cell drawn out into a lobe, or at least, more or less acute; femora never armed. . . . **Ulidinæ.**
   Posterior angle of anal cell obtuse; rounded or retracted; femora armed in most of the genera. . . . **Richardiinæ.**

PYRGOTINÆ.

Front strongly projecting; face retreating; oral opening small; proboscis not incrassated; clypeus but little developed; ocelli absent; no pro-pleural bristle; first longitudinal vein hairy; ovipositor not flattened (1). . . . . **Pyrgota.**

PLATYSTOMINÆ,

Oral opening very large; clypeus generally very much developed, and the proboscis proportionately stout; third antennal joint elongate; mesonotum bristly on the hind part only; pro-pleural and meso-pleural bristles absent; female abdomen with five segments; ovipositor flattened; first longitudinal vein bristly.

* *Tetropismenus* Loew has the third antennal joint circular, but its short stigma or subcostal cell locates it among the Ortalinæ.

1. The picture of the wings consists chiefly of a dark border along the costa, from the base of the stigma to the tip of the wing, with the first basal cell and the posterior cross-vein clouded; anterior cross-vein oblique. 6
   Flies not having the above characters. 2

2. Posterior angle of the anal cell drawn out into a sharp point. **Ostracocœlia.**
   Posterior angle of the anal cell rounded. 3

3. Picture of the wings dark, varied with transparent spots and bars. 4
   Wings not so marked. 5

4. Scutellum large, flat; occiput but little swollen; veins of wings straight and markedly divergent. . . **Amphicnephes.**
   Scutellum smaller, not flattened; occiput much smaller; epistoma strongly projecting; third and fourth longitudinal veins nearly parallel, sinuous. . . . . **Platystoma.**

5. The picture of the wings consists of four blackish cross-bands, of which the third is nearly perpendicular, and the fourth lies along the costa at the apex of the wing; scutellum with four bristles (**5**). . . . . **Rivellia.**
   Wings without bands; scutellum with two bristles; ant-like flies. **Myrmecomyia.**

6. Posterior cross-vein prolonged beyond the fourth vein; scutellum with six bristles, ... **Himeroessa.**
   Posterior cross-vein not prolonged. 7

7. Fifth longitudinal vein bristly. . . . . **Briciniella.**
   Fifth longitudinal vein not bristly;* scutellum with four bristles (**2**). **Stenopterina.**

CEPHALIINÆ.

Oral opening very large; clypeus and proboscis greatly developed; propleural bristle absent; mesopleural bristle present; sixth segment of the abdomen in the female distinctly developed; ovipositor flattened; first longitudinal vein bristly.

1. Slender, Sepsis-like flies, resembling Myrmecomyia, with wings almost hyaline, except for a small infuscation at the stigma and at the tip. . . . . **Cephalia.**
   Wings with a conspicuous picture. 2

* I can not see wherein *Bricinnia* Walker, to which Giglio-Tos refers a Mexican species, differs from *Stenopterina*.

2. Wings dark, with three oblique, more or less arcuated, hyaline cross-bands; first basal cell expanded before its end. **Tritoxa.**
   Wings not with such markings. 3
3. Wings broad, with a marked excision on the costa near the end of the auxiliary vein; second vein sinuous (3). **Camptoneura.**
   Flies not having such wings. 3
4. Posterior angle of the anal cell retracted (4). . . **Idana.**
   Posterior angle of the anal cell drawn out into a long hole. **Diacrita.**

ORTALINÆ.

The Ortalinæ differ from the Platystominæ and Cephalinæ in the usually small oral opening, the less developed clypeus, more slender proboscis and smaller palpi. The mesonotum is sometimes bristly in the middle anteriorly, the propleural and mesopleural bristles both present. Female abdomen with six segments.

1. Face sharply carinate. 2
   Face not sharply carinate. 3
2. Third antennal joint circular; hairy species. **Tetropismenus.**
   Third antennal joint ending in a sharp point; pollinose flies. **Tephronota.**
   Antennæ nearly as long as face, rounded at tip; mouth large. **Hiatus.***.
3. Mesonotum bristly in the middle in front; third antennal joint excised above and with a pointed tip (12). . . **Melieria.**
   Mesonotum not bristly in the middle in front. . . . 4
4. Third antennal joint distinctly excised above, pointed at the tip; fourth longitudinal vein with a marked anterior curvature on its distal part. . . . . **Anacampta.**
   Third antennal joint not excised above; fourth vein not so curved. 5
5. Tibiæ with preapical bristle. . . . . **Automola.**
   Tibiæ without such bristle. . . . . **Tetanops.**

PTEROCALLINÆ.

Trypeta-like; coloring nonmetallic; head rather broad, but low, with rather protuberant eyes; face short, perpendicular, excavated in the middle; clypeus but little developed; third antennal joint round or short oval; mesonotum bristly upon the posterior part only; first longitudinal vein and auxilary vein remote from each other at tip; posterior angle of the anal cell often drawn out into a long lobe.

* Cresson. Trans. Amer. Ent. Soc. xxxii, 286. 1906.

1. Posterior angle of anal cell drawn out into a long lobe; posterior cross-vein very oblique. 2
   Posterior angle of anal cell not greatly produced. . . . 3

2. Wings proportionately narrow, of equal width; round at tip (11). **Pterocalla.**
   Wings with much curved hind margin. . . **Callopistria.**

3. Anterior and posterior cross-veins very oblique. . . . 5
   Posterior cross-vein rectangular or nearly so. 5

4. Scutellum with two bristles. . . . . **Xanthachrona.**
   Scutellum with four bristles. . . . . **Myennis.**

5. Second longitudinal vein straight or nearly so; anterior cross-vein not oblique. 6
   Second longitudinal vein markedly sinuous; cross-veins approximated and the anterior one very oblique. **Paragorgopis.***

6. Cheeks rather broad; posterior angle of anal cell acute (7). **Pseudotephritis.**
   Cheeks and face extremely short; eyes transversely oval; posterior angle of anal cell rectangular. . . . **Psairoptera.**

ULIDIINÆ.

Head large, hemispherical, proboscis stout, with broad labella; front broad; antennæ usually short; mesonotum bristly in the middle behind only; first and third longitudinal veins of the wing bare; posterior angle of the anal cell acute, sometimes drawn out into a long lobe.

1. Head conspicuously large; antennæ widely separated at base; cheeks and face swollen. 2
   Head not conspicuously large; antennæ not unusually remote at base. 4

2. Eyes round, about one-half the height of head. . . . 3
   Eyes higher than long. . . . . **Parœdopa.**†

3. Third joint of antennæ rounded; front not rugose above (8). **Oedopa.**
   Third joint of antennæ elongate; front rugose above. **Eurycephala**

4. Antennæ long; third joint unusually long. . **Stictomyia.**†
   Antennæ shorter, the joint more or less oval. . . . 5

* This genus is located here as definitely as the characters given will permit.

† These genera are inserted after Cresson, 1906, 7.

5. Posterior angle of anal cell acute, but scarcely prolonged lobe-like. 12
   Posterior angle of anal cell distinctly drawn out into a lobe. 6

6. Front punctate or scrobiculate.* 7
   Front smooth. 10

7. Scutellum flat, with sharp edges; fourth longitudinal vein strongly curved forward at its distal end; front coarsely rugose. . 9
   Scutellum convex, rounded on its edges. 8

8. Stigma not unusually elongate. , ... **Ulidia.**
   Stigma elongate, about as long as the costal cell. **Acrosticta.**
   Wings with cross-bands (18). . . . . **Euphara.**

9. Third antennal joint elongate (17). . . **Notogramma.**
   Third antennal joint not elongate. . . . **Chrysomyza.**

10. Face distinctly projecting below; third antennal joint rounded at the end. 11
    Face retreating; third antennal joint with a sharp anterior angle. (9). . . . . **Chætopsis.**

11. Third antennal joint twice as wide as long. . . **Zacompsia.**
    Third antennal joint not twice as wide as long (16.) **Euxesta.**

12. Body extremely slender. 13
    Body not slender; face carinate. . . . . **Seoptera.**

13. Front only slightly projecting in profile; face oblique. **Stenomyia.**
    Front very much projecting, so that the head is conical and the face nearly horizontal (13). . . . . **Eumetopia.**

RICHARDIINÆ.

Mesonotum with bristles in the middle posteriorly only; femora often armed and incrassate; first longitudinal vein bare; posterior angle of the anal cell obtuse; costal vein usually broken just before the termination of the auxiliary vein; auxiliary and first longitudinal veins closely approximated, their tips near together.

1. Femora all armed with spines. 3
   Front and hind femora only, with spines. . . **Sepsisoma.**
   Front and middle femora unarmed. 2
   All the femora unarmed. . . , ... 5

* Smooth in *Acrosticta bicolor* Cresson.

2. Hind femora incrassate (14). . . . . **Richarula.**
Hind femora not incrassate. . . . . **Paneryma.**

3. Scutellum with two bristles. 4
Scutellum with four bristles; ocelli remote from the vertex; last section of the fourth vein convergent toward the third (10). **Cœlometopia.**

4. Ocelli approximated to the vertex; front not narrowed anteriorly. **Neoidiotypa.**
Ocelli remote from the vertex; front somewhat narrowed anteriorly; wing narrowed at base (22). . . **Stenomacra.**
Front projecting; wings not narrowed at base. **Cyrtometopa.**

5. Head shaped like a long, somewhat flattened cone. **Coniceps.**
Head not so shaped. 6

6. Wings but little developed; anal cell wanting. **Steneretma.**
Anal cell present; wings fully developed. . . **Epiplatea.**

XXXVIII. Family RHOPALOMERIDÆ.

Front broad, excavated, with or without short orbital bristles. Antennæ short, third joint rounded or oval, the arista bare or plumose. Face broad, carinate, tuberculate or the oral margin prominent; cheeks broad; clypeus projecting; vibrissæ wanting; proboscis short; palpi slender or dilated. Thorax elongate, arched, mesonotum nearly bare; scutellum often prominent and grooved. Abdomen shorter than the wings, flattened; ovipositor projecting, telescopic; hypopygium largely concealed. Femora thickened, the hind tibiæ often dilated. Auxiliary vein present or absent; basal cells well developed.

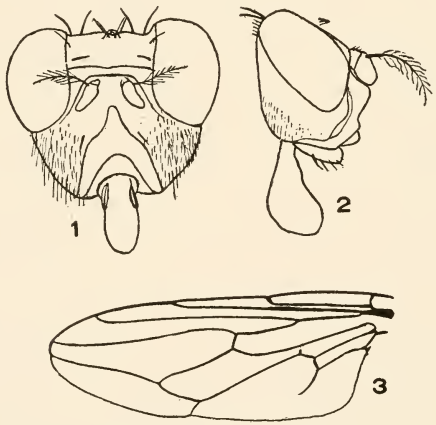


Fig. 110. Rhopalomeridæ. 1, *Willistoniella*, head from in front; 2, *Apophyrhynchus*, head; 3, *Rhopalomera*, wing.

This group comprises a small number of flies from six to twelve millimeters in length, of peculiar aspect, having a general resemblance to some of the Ephydridæ or

Sapromyzidæ. I know nothing of their habits, whether in the adult or immature stages, though I suspect that they are denizens of wet or damp places. The known species are confined to Central and South America.

The group is evidently sharply divided into two minor groups, by the presence or absence of the auxiliary vein and the length of the first longitudinal vein.

TABLE OF GENERA.

1. Auxiliary vein wanting, the first longitudinal vein short; first posterior cell of the wings not narrowed; palpi slender (*Rhinotorinæ*). . . . . **Rhinotora.**

   Auxiliary vein well-developed, the first longitudinal vein longer; first posterior cell much narrowed in the margin; palpi dilated (*Rhopalomerinæ*). 2

2. Scutellum oval; arista plumose. 3

   Scutellum pyramidal, directed obliquely upward; arista plumose or bare (**3**, **7**, p. 34). . . . . **Rhopalomera.**

3. Front with bristles; face carinate; hind tibiæ dilated and with tubercles (**1**). . . . . **Willistoniella,** Mik.

   Front without bristles; face tuberculate; hind tibiæ slender (South America). . . . **Apophorhynchus** Williston.

XXXIX. Family TRYPETIDÆ.

Fig. 111. *Straussia longipennis*, enlarged. After Kellogg.

Head hemispherical; face nearly vertical in profile, or somewhat retreating, without distinct vibrissæ. Front broad, bristly on the sides, the lower fronto-orbital bristles situated close to the border of the eyes. Antennæ decumbent, short, rarely elongated. Abdomen composed of four or five segments; genitalia of the males but little exposed; the ovipositor jointed, more or less projecting, Wings rather large; auxiliary vein present, ending steeply and obscurely in or near the border; posterior basal cell and the anal cell distinct, the latter often drawn out into an acute, often prolonged, point. Wings usually with dark markings. Legs moderately long; tibiæ without preapical bristle. Proboscis moderately long, usually with broad labella; sometimes long, and the narrow labella folding backwards.

This family comprises a large number of rather small flies usually with prettily marked wings. The larvæ are not elongate, conical and round; the posterior stigmata lie free in two separated small, chitinous platelets, forming three radiating depressions; antennæ short, two-jointed; mouth hooklets separated, thick and strong; anal end somewhat impressed, often in the middle with

six small; fleshy points. Puparia elliptical; the anterior stigmata projecting somewhat buttonlike. The larvæ of *Ceratitis* live in the flesh of oranges and lemons, those of *Aciura* have been found at the base of the flower stems of *Phlomis*, those of *Acida* mining in the leaves of *Rumex*, those of *Spilographa* mining in the leaves of *Senecio*, or *Arctium* or bred from the berries of *Solanum carolinensis*, in the fruit of *Prunus* and *Lonicera*, etc.; those of *Ensina*, in the blossoms of *Senchus;* those of *Tephritis* in the blossoms and galls of the stems or roots of various compositæ; those of *Carphotricha* in the galls and roots of *Achillea*, the flowers of *Hieracium*, etc.; those of *Trypeta* in the heads of *Cirsium*, *Centaurea*, etc., and in stems of plants.

TABLE OF GENERA.

1. Ovipositor of female remarkably elongated; second longitudinal vein usually with a slump of a vein (19). **Toxytrypana.**
   Ovipositor not remarkably elongated and curved. . . 2

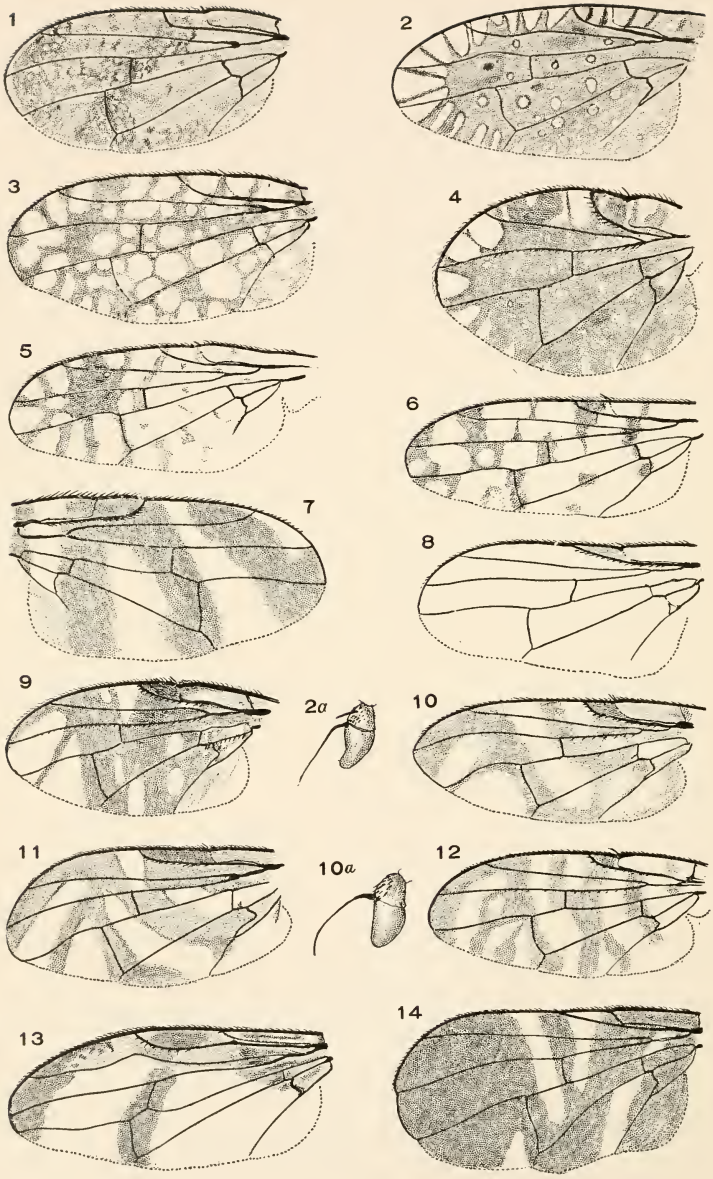
2. Front on each side with a bristle having a terminal, leaflike appendage. . . . . **Ceratitis.**
   Front without such bristles. 3

3. Wings with colored markings not reticulate. 4
   Wings hyaline or with the markings reticulate or spotted. . 19

4. Scutellum with six bristles (9). . . . **Hexachæta**
   Scutellum not with six bristles. 5

5. Fourth longitudinal vein conspicuously curved forward at its tip (11, 20). . . . . **Anastrepha.**
   Fourth longitudinal vein not conspicuously curved forward at its extremity. 6

6. Distal portion of the wings with two hyaline indentations, separated by a curved or arched brown projection from the brown oblique cross-band or spot before it, the anterior indentation more slender, the posterior one (in the second posterior cell, crossing or not the fourth vein) more triangular in shape. 7
   Wings with three such indentations. . . . **Polionota.**
   Wings not so marked. 11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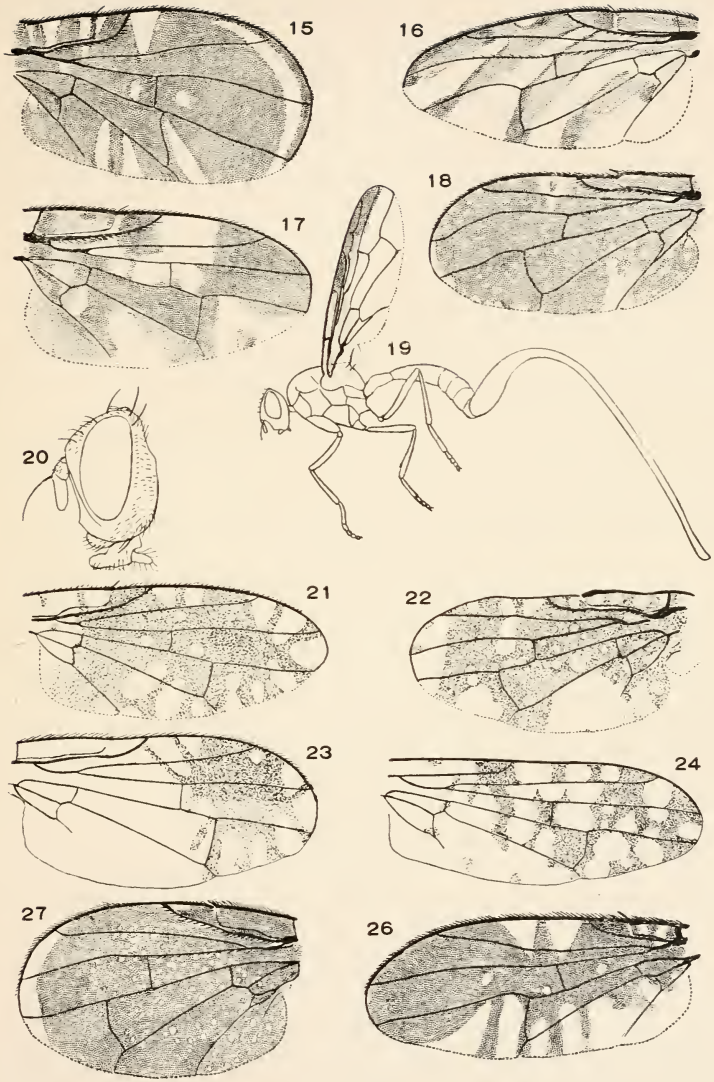


Figs. 112, 113. Trypetidæ. 1, *Icterica;* 2, *Carphotricha;* 3, *Euaresta;* 4, *Eutreta;* 5, *Urellia;* 6, *Tephritis:* 7, *Oedaspis;* 8, *Neoaspilota;* 9, *Hexachæta;* 10, *Straussia;* 11, *Anastrepha;* 12, *Oedicarena:* 15, *Polymorphomyia;* 16, *Plagiotoma;* 17, *Xenochæta;* 18, *Eurosta;* 19, *Toxotrypana* (Snow); 20, *Anastrepha,* head; 21, *Euaresta;* 22, *Eurosta;* 23, *Urellia:* 24, *Eusina:* 26, *Aciura:* 27, *Eutreta.*

7. Body elongate; abdomen narrower than the thorax. . . 8
Body short; abdomen as broad as the thorax. . . . 9

8. The hyaline triangle at tip of first vein does not cross the third vein (10). . . . . **Straussia.**
The hyaline triangle at tip of first vein crosses the third vein. **Molynocœlia.**

9. The horizontal diameter of the eyes remarkably short. **Stenopa.**
Horizontal diameter of eyes not shorter than usual. . . 10

10. Antepenultimate section of fourth vein straight. . **Acidia.**
Antepenultimate section of fourth vein curved. **Epochroa.**

11. Coloring of the body general light, never black. . . 12
Coloring of the body black. 16

12. Wings near the middle with two cross-bands, converging toward the posterior margin. 13
Wings not with such cross-bands. 14

13. The third longitudinal vein is gently curved backward toward the tip; head not swollen. . . . . **Spilographa**
Third longitudinal vein straight to the extremity; head distinctly swollen (12). . . . . **Oedicarena.**

14. Wings with four very oblique cross-bands. 15
Cross-bands nearly transverse, or dissolved into spots; cross-veins but little oblique. . . . . **Trypeta.**

15. Scutellum tumid, bituberculate. . . . . **Peronyma.**
Scutellum of the usual structure, not swollen, though convex (16). **Plagiotoma.**

16. Cross-veins conspicuously approximated. . . . ; 17
Cross-veins not approximated. 18

17. Wings with hyaline indentation and a subapical, arcuate hyaline cross-vein; scutellum black (15). . **Polymorphomyia.**
Wings with three brown bands or projections, connected anteriorly, the distal one following the costa, the middle one beyond the middle of the wing, the proximal one toward the base (7). **Oedaspis.**

18. Scutellum with four bristles, yellow; wings with black cross-bands. **Rhagoletis.**
Scutellum with two bristles, black; wings with hyaline indentations along the margin (26). . . . . **Aciura.**

19. Fifth vein strongly bristly; scutellum with six bristles. **Blepharoneura.**
Fifth vein not bristly, scutellum with four or two bristles. 20

20. Wings banded on the apex. 21
Wings not banded on the apex 22

21. Middle portion of wings finely reticulated. . . **Acrotænia.**
Middle portion of wings not finely reticulated. **Baryphlegma.**

22. Face spotted. 23
Face not spotted. 24

23. Wings very much dilated; pattern of picture not radiating (4, 27). **Eutreta.**
Wings not dilated; with radiating markings along the margin (2). **Carphotricha.**

24. Front very broad. 25
Front not very broad. 27

25. Third antennal joint elongate, with a sharp anterior angle; ovipositor flattened. . . . . **Acidogona.**
Third antennal joint short. 26

26. Wings with numerous small spots and larger ones along the distal margin; ovipositor conical (18, 22). . . . **Eurosta.**
Wings with large, irregular brown spots and hyaline spaces (17). **Xenochæta.**

27. Wings without markings, or, on the apical half only with a reticulation dissolved into cross-bands (8). . **Neoaspilota.**
Flies not having the above characters. 28

28. Wings of an evenly broad shape and with an unusually blunt distal extremity (1). . . . . **Icterica.**
Wings of the usual shape, or dilated. 29

29. Labella very much prolonged (24). . . . . **Ensina.**
Labella not or but little elongated. 30

30. Wing-markings radiating. 31
Wing-markings not radiating (6). . . . **Tephritis.**

31. The whole, or nearly the whole surface of the wings with an unicolorous recticulation (3, 21). . . . . **Euaresta.**
A star-shaped picture at the distal extremity of the wings, the re. remaining surface immaculate, or with a very few spots, or at the most with an obsolete reticulation (5, 23). **Urellia.**

XL. Family SAPROMYZIDÆ.

Small species, seldom more than seven millimeters in length. Head as broad or a little broader than the thorax; front with one or two bristles on each side anteriorly to those of the vertex; post vertical bristles convergent. Antennæ usually porrect, the third joint more or less elongated. Face without vibrissæ on the oral margin. Abdomen short ovate. Legs never elongate. Auxiliary vein of wings distinct; cross-veins never approximated; basal cells never obsolete.

I include in this family the Sapromyzidæ and Lonchæidæ of Loew, Becker and other writers, since I believe that the relationship between such genera as *Palloptera* and *Sapromyza* is evident, though I appreciate the differences, and am not very insistent upon their union. The wings of both the Lonchæinæ and Sapromyzinæ are often pictured. Czerney would include the Ochthiphilinæ (Agromyzidæ) in this family.

The larvæ of *Sapromyza* live in decaying vegetable matter; they are slender, with two distinct mouth-hooklets; the entire body, except the anterior segments roughened by very small bristles. The segments are distinctly constricted, the penultimate segment with four conical processes in a transverse row, the terminal segment with two three-jointed processes, between which is the cylindrical stigmatic tube. In *Lonchæa* there are no conical processes on the penultimate segment, and the stigmatic tubes or processes are small and wart-like.

TABLE OF GENERA.

1. Tibiæ without preapical bristle; front with a single orbital bristle; ovipositor horny and flattened (*Lonchæinæ*). . . . 2

Tibiæ with a distinct preapical bristle; two fronto-orbital bristles; ovipositor not horny, ending tube-like (*Sapromyzinæ*) . 3

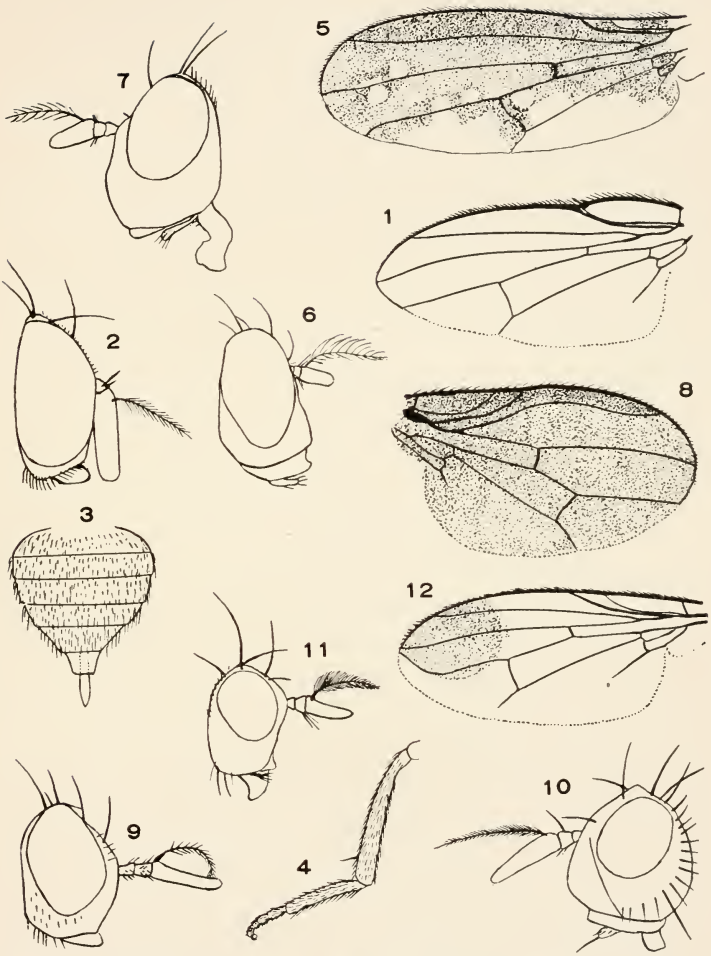


Fig. 114. Sapromyzidæ. 1, *Lonchæa*, wing; 2, *Lonchæa*, head; 3, *Lonchæa*, abdomen of female; 4, *Sapromyza*, tibia and tarsus; 5, *Sapromyza*, wing; 6, *Physogenua* (gen. nov.?) head; 7, *Physogenua*, head; 8, *Lauxania* wing; 9, *Lauxania*, head; 10, *Pachycerina*, head (Becker); 11, *Pachycerina verticalis*, head; 12, *Griphoneura*, wing.

2. Metallic black species; front rather narrow (1, 2, 3). **Lonchæa.**
   Yellow or yellowish species; front broad (p. 80, 15). **Palloptera.**

3. Arista with short and dense plumosity; anterior fronto-orbital bristles proclinate (10, 11). . . . . **Pachycerina.**
   Arista bare, pubescent or loosely plumose; anterior fronto-orbital bristles reclinate. 4

4. Face broad, in profile strongly convex below (6, 7). **Physogenua**
   Face receding, flattened or gently arched. 5

5. First posterior cell much narrowed in the margin (12). **Griphoneura.**
   First posterior cell not or but slightly narrowed in the margin. 6

6. Shining black species; third joint of antennæ more elongate (8, 9). **Lauxania.**
   More or less yellow or pollinose species; third joint of antennæ less elongate (4, 5). . . . . **Sapromyza.***

* From the description and figures I can discover no differences, save the imperfect anal cell, an unimportant character, to distinguish *Chætocœlia* from those species of *Sapromyza* having pictured wings.

Sapromyza, species; enlarged.

XLI. Family AGROMYZIDÆ.

Front broad, with or without bristles. Antennæ short, the third joint usually rounded, sometimes a little elongate or subquadrate; oral vibrissæ usually present. Arista bare or pubescent, never distinctly plumose; rarely wanting. Genitalia rarely prominent. Wings broad; auxiliary vein vestigial or indistinct, never clearly separated, save sometimes in its proximal part, from the first vein. Second basal and anal cells always small, oftentimes indistinct, or the second basal united with the discal; cross-veins often much approximated, never very remote from each other.

This family of small or minute flies, as here defined, includes four or five groups which various authors have either given independent rank or united with other groups. Czerny would unite the Ochthiphilinæ with the Sapromyzidæ, in which view I do not concur. The limits of the Agromyzinæ and Milichinæ, if there be any, will only be determined for our American genera by a more exhaustive study than I can give to them; several of the genera I do not know: *Eusiphona*, *Hemeromyia*, *Arctobiella*, *Parodinia*. Czerny and Hendel make different combinations than do most other authors. The Agromyzinæ, according to these authors, have divergent postvertical bristles, the Milichinæ and Ochthiphilinæ convergent.

From the Drosophilidæ the members of this family will be distinguished easily (in the American forms) by the nonplumose or nonpectinate arista. Nearly all the genera are at once distinguished from the Oscinidæ and Ephydridæ by the distinct, though small, posterior basal cells; but this character is sometimes difficult to detect

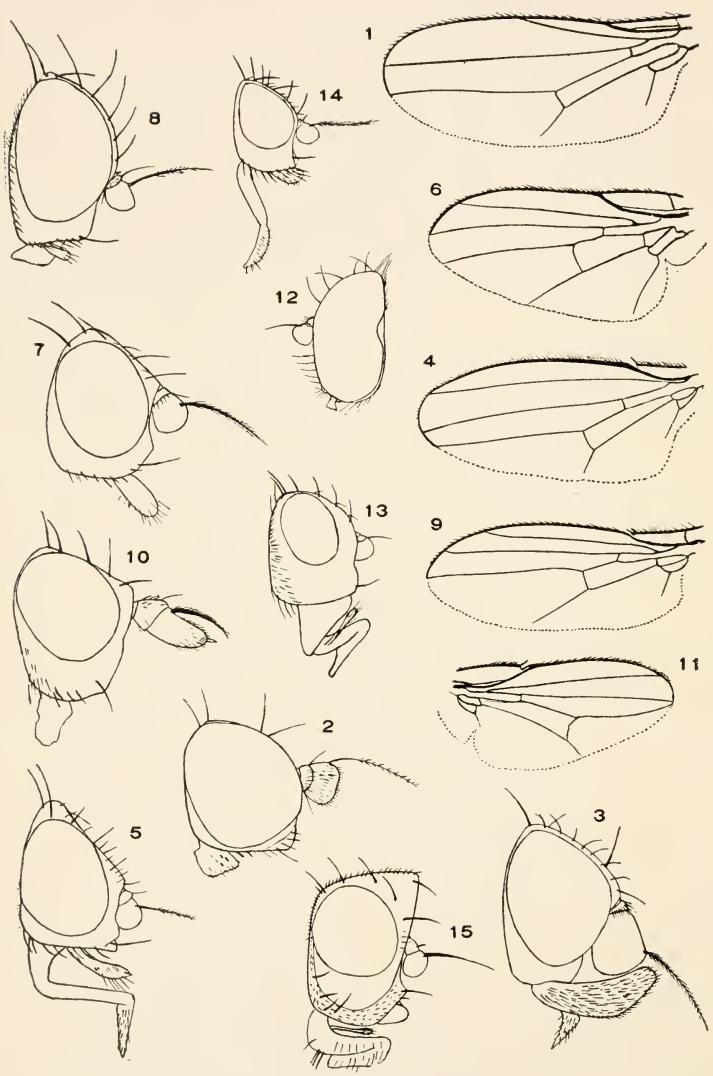


Fig. 115.

Figs. 115, 116. Agromyzidæ. 1, *Aulacigaster*, n. sp. (West Indies), wing; 2, *Aulacigaster*, same species, head; 3, *Phyllomyza magnipalpis*, head (♂); 4, *Platophrymyia nigra*, wing; 5, *Platophrymyia*, id. head; 6, *Agromyza xanthophora*, wing; 7, *Agromyza* (gen. nov.?) head (♂); 8, *Agromyza jucunda*, head; 9, *Ceratomyza dorsalis*, wing; 10, *Ceratomyza*, id. head; 11, *Ophthalmomyia lacteipennis*, wing; 12, *Ophthalmomyia*, id. head (♂); 13, *Rhicnoessa cinerea*, head (♂); 14, *Desmometopa*, sp. head; 15, *Traginops irrorata*, head(Coquillett); 16, *Phytomyza*, sp. Phytomyzinæ; 17, *Ochthiphila polystigma*, Ochthiphilinæ; 18, *Paramyia*, sp. (Georgia), Phytomyzinæ (?); 19, *Milichia leucogaster*, Milichinæ; 20, *Agromyza*, sp., Agromyzinæ.

in such small insects, and will usually require the use of a compound microscope; indeed such a microscope, with a one inch or half inch objective, is advised for the study of most of the species of the family. The absence or presence of the basal cells is not an important character in these and allied flies, and may not even have specific value. *Aulacigaster* has been located in various families, but it seems to find its most natural place here. From the Geomyzidæ the distinction of some of the genera is very difficult, if not impossible at present. One would better consult that family in case of doubt.

The larvæ of *Phytomyza*, and probably also of *Paramyia*, are leaf miners; those of *Ochthiphila* have been found in the galls of *Triticum repens*. The larvæ of *Agromyza* are elliptical in shape, the hind stigmata situated upon small rounded plates on the under side of the last segment; the abdomen is provided with false legs, without bristles. The larvæ of *Leucopis* are cylindrical, thicker posteriorly; the skin roughened with short hairs; hind stigmata elongate, tube-like and widely separated. The larvæ creep leech-like, or like geometrid larvæ.

TABLE OF GENERA.

1. Posterior cross-vein absent (Phytomyzinæ). 2
   Posterior cross-vein present. 3

2. Proboscis elongate, folding; palpi long and thickened (18). **Paramyia.**
   Proboscis and palpi not elongated (16). . . **Phytomyza.**

3. First posterior cell narrowed in the margin; proboscis long and geniculate.* . . . . . **Eusiphona.**
   First posterior cell not or but slightly narrowed in the margin. 4

4. Posterior cross-vein situated before the middle of the wing, the two cross-veins approximated. 5
   The cross-veins not approximated. 12

*I do not know this genus, originally described as a tachinid; it must have a curious resemblance to *Stylogaster* (Conopidæ).

5. Posterior cross-vein opposite or before the anterior cross-vein, that is the second basal and distal cells together are but little longer or shorter than the first basal cell. . . **Napomyza.**
Posterior cross-vein at least its own length beyond the anterior cross-vein. 6

6. The third antennal joint terminates in a spiny point (**9, 10**). **Ceratomyza.**
Third antennal joint not terminating in a spiny point. . 7

7. Third antennal joint rounded, of moderate size. . . . 8
Third antennal joint very large, subquadrate (**3**). **Phyllomyza.**

8. Arista wholly wanting; second basal and discal cells confluent. **Cryptochætum.**
Arista present. 9

9. Proboscis long and geniculate. 10
Proboscis short and not geniculate. 11

10. Front long and plane, or concave, longitudinally (**4, 5**). **Platophrymyia.**†
Front shorter and convex (**14**). . . . **Desmometopa.**

11. Vibrissæ distinctly above oral margin; face strongly convex. **Hemeromyia.**
Vibrissæ not distinctly above the oral margin (**6, 7, 8, 20**). **Agromyza.**
No distinct vibrissæ (see Ephydridæ, (**25, 36**). . **Pelomyia.**

12. Second basal cell united with the discal cell; first basal cell but little longer than the anal (**1, 2**). . . **Aulacigaster.**
Discal cell separated from the second basal. 13

13. Oral vibrissæ present (Milichinæ). 14
Oral vibrissæ wanting; postvertical bristles convergent; auxiliary vein usually distinct from first longitudinal through a considerable part of its course (Ochthiphilinæ). 21

14. Costa with a distinct incision before the tip of the first vein. 15
Costa not with such incision. 16

15. First posterior cell narrowed in the margin; posterior orbits with a distinct incision (**11 12**). . . . **Ophthalmomyia.**
First posterior cell not narrowed in the margin; posterior orbits not incised (**19**). . . . . **Milichia.**

† I am not sure of the distinction of this genus from *Desmometopa*.

16. Front projecting forward anteriorly in a high angular eminence (15). . . . . **Traginops.**
Front not so projecting. 17

17. Vibrissæ not well differentiated from the adjacent hairs; rather thickly haired species; eyes densely pubescent. **Arctobiella.**
Vibrissæ distinctly differentiated. 18

18. Mesonotum with bristles on the sides only. . . **Cacoxenus.**
Mesonotum with bristles in the middle also. . . . 19

19. Only two pairs of fronto-orbital bristles. . . **Parodinia.**
Three or four pairs of fronto-orbitals. 20

20. In addition to the usual fronto-orbital bristles there is an inner row of frontal bristles or bristly hairs (13). . **Rhicnoessa.**
No additional row of bristles. . . . . **Odinia.**

21. Head triangular in outline, the front strongly projecting, the face much retreating, almost horizontal. . . **Acrometopia.**
Head not of such form. 22

22. No orbital or ocellar bristles. . . . . **Leucopis**
Orbital bristles present. 23

23. Front with a transverse groove near the middle. **Pseudodinia.**
Front not with transverse groove (17). . **Ochthiphila.**

XLII. Family GEOMYZIDÆ.

Head rounded, usually with vibrissæ at oral margin; front broad, with one, two or three pairs of fronto-orbital bristles; postvertical bristles convergent. Antennæ short, the third joint rounded or a little elongated, with a bare, pubescent, pectinate or plumose arista. Wings comparatively long; auxiliary vein always coalescent distally with the first vein; posterior basal and the anal cells small but distinct.

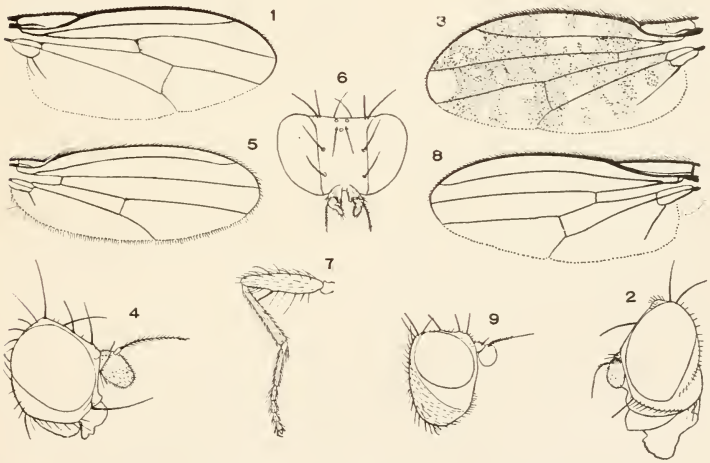


Fig. 117. Geomyzidæ. 1, *Sinophthalmus pictus*, wing; 2, *Sinophthalmus pictus*, head; 3, *Spilochroa ornata*, wing; 4, *Spilochroa ornata*, head; 5, *Anthomyza tenuis*, wing; 6, *Anthomyza tenuis*, front; 7, *Anthomyza tenuis*, front leg; 8, *Chiromyia flava*, wing; 9, *Chiromyia flava*, head.

This small group of small flies, as here limited, includes the Geomyzidæ and Opomyzidæ of Loew, and the Anthomyzidæ of Czerny. The limits of the family are

not at all sharp, and no two writers agree as to what they are; indeed there seem to be none. *Curtonotum* is not included here, but will be found among the Drosophilidæ. *Tauromyia*, which v. d. Wulp thought might belong to this group, is most assuredly not a Geomyzid.

The larvæ of those few species of which the habits are known, live in the stems of plants.

TABLE OF GENERA.

1. Oral vibrissæ distinctly differentiated. 2
   Oral vibrissæ absent or indistinctly differentiated from adjacent hairs. 8

2. Mesonotum bristly in the middle in front. 3
   Mesonotum bristly in the middle on the posterior part only. 5

3. Arista pectinate above; one orbital bristle. . . **Balioptera.**
   Arista not pectinate; two fronto-orbital bristles. . . . 4

4. Cheeks as broad as the vertical diameter of the eyes; wings unmarked. . . . . **Zagonia.**
   Cheeks narrow; wings variegated (*Heterochroa* (*Peratochætus*) *ornata* Johnson) (**3, 4**). . . . **Spilochroa** Will.

5. Under side of front femora with bristles or bristle-like spines. 6
   Under side of front femora not with bristles or spines. **Diastata.**

6. Second longitudinal vein strongly curved forward, flexuous (p. 80, **14**). . . . . **Ischnomyia.**
   Second longitudinal vein not flexuous. 7

7. Face with a nose-like carina above; no postvertical bristles; front with one proclinate bristle on each side (**1, 2**).
   Sinophthalmus.
   Face not carinate; two reclinate bristles on each side (**5, 6, 7**).
   Anthomyza.

8. Occiput flattened; wings spotted. 9
   Occiput convex; wings not spotted (**8, 9**, *Scyphella*).
   Chiromyia Bezzi.

9. Arista long plumose. . . . . **Scutops.**
   Arista not plumose. . . . . **Opomyza.**

XLIII. Family DROSOPHILIDÆ.

Face nearly vertical in profile, with oral vibrissæ, which are sometimes weak. Front with long bristles, not reaching to the anterior part; postvertical bristles convergent; foremost orbital bristle usually proclinate. Third joint of the antennæ oval or rounded, the first two short: arista almost always plumose or strongly pectinated, though sometimes the rays may be much reduced in number or, rarely, entirely wanting. Abdomen usually short; more elongate in *Curtonotum*. Auxiliary vein incomplete or indistinct: an incision in the costa before the termination of the first vein; first longitudinal vein short, not reaching a third of the length of the wing; posterior basal cell usually united with the discal cell, though sometimes complete; anal cell usually present, but sometimes indistinct or entirely wanting; posterior cross-vein absent in *Asteia*.

The species of this family are almost always small, seldom exceeding a length of five or six millimeters and usually from one to three; of rather a plump appearance, giving a feeling of coldness to the fingers when grasped. The bristles of the front are usually conspicuous, but the body is without hair. The flies are often caught with the beat-net, and some species are especially abundant about decomposing or fermenting fruit, cider refuse, wine vats, vinegar, etc.; and some are annoying to the housewife about preserves; even the breath of one who has recently drank wine seems to attract them.

The great majority of the species the student meets are easily enough located by the absence of the auxiliary vein and second posterior cell together with the plumosity of the arista and distinct oral vibrissæ. Unfortunate-

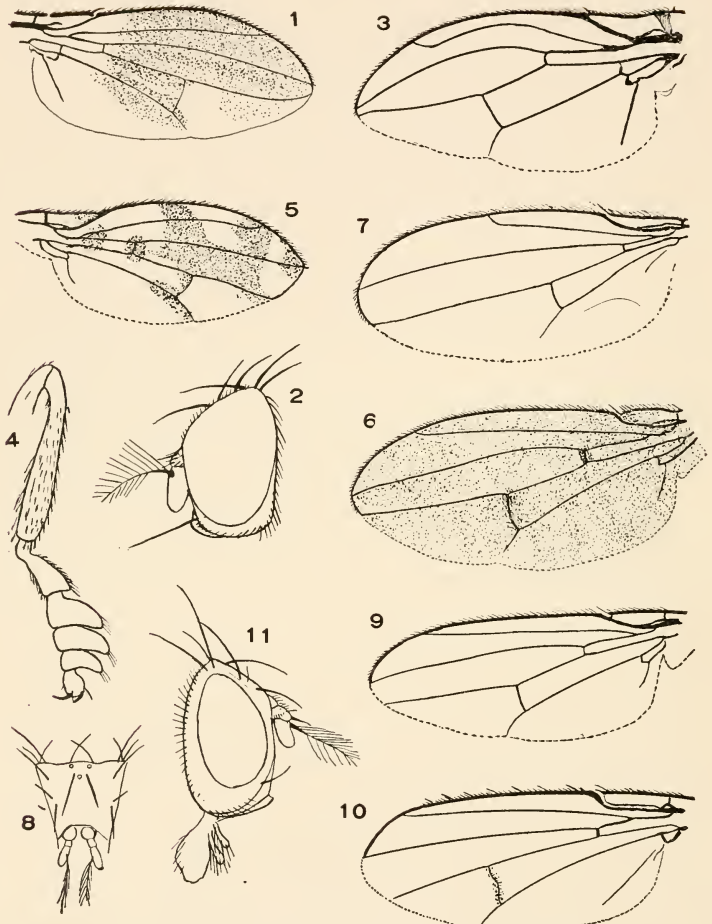


Fig. 118. Drosophilidæ. 1, *Phortica*, wing; 2, *Phortica*, head; 3, *Stegana*, wing; 4, *Stegana*, front leg of male; 5, *Drosophila*, wing; 6, *Drosophila*, wing; 7, *Sigaloessa*(?); wing; 8 *Drosophila*, front, showing bristles; 9, *Leucophenga*, wing; 10, *Curtonotum*, wing; 11, *Curtonotum*, head.

ly there are not a few which, as at present understood, are not so easily distinguished from two or three other families, especially the Ephydridæ and Oscinidæ, those in which the second basal cell is usually incomplete; and the student would best consult those families when in doubt. *Aulacigaster* has been refused admission here and referred to the Ephydridæ by some; others would locate it here or among the Agromyzidæ. *Curtonotum* has also somewhat doubtful claims for admission here, since the auxiliary vein, in some species at least, is less rudimentary. Because of the characteristically proclinate foremost orbital bristle and general structure of the head, especially, I believe that its claims are good for location with the true Drosophilidæ; at least I am confident that it does not belong with the Geomyzidæ, where it is often located. *Asteia* and *Sigaloëssa*, or at least the former, were placed by Loew in a distinct family. True *Sigaloessæ* agree best in habitus with the Oscinidæ; but there are other forms that must for the present at least be placed in the genus, which seem to be nearest to *Drosophila*. *Stenomicra*, judging from the description, must also be an aberrant form.

TABLE OF GENERA.

1. Discal and second basal cells united. 3
   Discal and second basal cells separated by a cross-vein. . . 2

2. Second and third veins markedly convex anteriorly; first posterior cell narrowed in the wing margin; front tarsi of male dilated (in some species at least); wings appearing as though broken down over the abdomen (3, 4). . . . . **Stegana.**
   Second and third veins not markedly convex; wings not appearing as though broken down (p. 80, 12, and 1, 2). **Phortica.***

* The species of *Phortica* figured in 1, 2 (from South America, a female specimen) has the first posterior cell much narrowed in the margin. *Phortica scutellaris* (West Indies) has the male front tarsi dilated, but the first posterior cell wide open. I do not know whether the dilated front tarsi is a generic character or not, or whether there are forms included in *Phortica* which should be separated generically.

3. Second section of the costa much shorter than the third;* anal cell wanting. 4
Second section of the costa at least as long as the third. . 5

4. Posterior cross-vein absent. . . . . **Asteia.**†
Posterior cross-vein present (**7** and **7** Oscinidæ). **Sigaloessa.**†

5. Arista bare, except for a single ray near its base; two fronto-orbital bristles on each side. . . . . **Cladochæta.**
Arista plumose or with numerous pectinations. . . . 6

6. The costa reaches to the third vein or a little beyond. . . 7
The costa reaches to the fourth vein or a little beyond. . . 8

7. Costa with sparse but conspicuous bristles; thorax arched, bristly behind; scutellum with long bristles; abdoman elongate, drooping; larger flies (**10, 11**). . . . . **Curtonotum.**
Costa not with bristly pectinations (**9**). . , **Leucophenga.**‡

8. Ultimate section of fourth vein seven or eight times longer than the penultimate; a single fronto-orbital bristle on each side; no alulæ; first posterior cell narrowed in the margin. **Stenomicra.**⁂
Ultimate section of fourth vein not more than four times the length of the penultimate; first posterior cell not appreciably narrowed in the margin (**5, 6, 8**). . . . . **Drosophila.**

* If first basal cell but little longer than the anal, and the arista bare or pubescent, see *Aulacigaster* (Agromyzidæ).

† I do not know *Asteia*, but the venation of the type species of the genus seems to be almost identical with that of *Sigaloëssa* as figured with the Oscinidæ (**7**), save that the posterior cross-vein is absent. The venation of *Sigaloëssa* as there given is the more typical; that given in fig. 7 herewith is apparently that of Schiner (South America and West Indies). In which family the genera should be placed is at present a mere matter of opinion.

‡ Including such species as *Drosophila frontalis* and perhaps others described as *Drosophilæ*.

⁂ This genus seems to be peculiar in its approximated cross-veins, and single fronto-orbital bristle. I do not know it.

XLIV. Family EPHYDRIDÆ.

Face more or less, often remarkably convex. Antennæ short; first joint small; antennal arista bare or pubescent, or pectinated upon the upper side. Oral cavity rounded, usually large; clypeus distinct, in some cases retracted within the oral cavity and not visible, in others very prominent; without distinct vibrissal bristle. Abdomen of variable form, composed of six segments in the males, seven in the females, never elongated; sexual organs usually retracted. Wings rarely aborted; auxiliary vein coalescent for the most part with the first longitudinal and distinct only at its proximal end; distinct throughout in *Canace;* costa broken before tip of first vein and more or less distinctly a little distance beyond the humeral cross-vein; second basal cell confluent with the discal cell, the anterior basal cross-vein entirely absent or only dimly visible: distinctly present in *Canace* only; anal cell imperfect and small; distinct in *Canace* and *Pelomyia*. Middle tibiæ with spur; no preapical bristle. Body usually bare or nearly so of hairs.

The flies of this family are never large, often small or even minute. The greater number of species are inhabitants of wet places, about marshy ground, meadows, etc., and are usually caught in the beating net. They are always thinly pilose or bare species, and never with bright colors. The extraordinarily large mouth of some species is very characteristic, but in others this character is not so apparent; and there is sometimes difficulty in separating the genera from those of the Drosophilidæ.

The name of 'brine flies' or 'salt water flies' has sometimes been given to the family, but not very happily, since the greater number live about fresh water. *Brachy-*

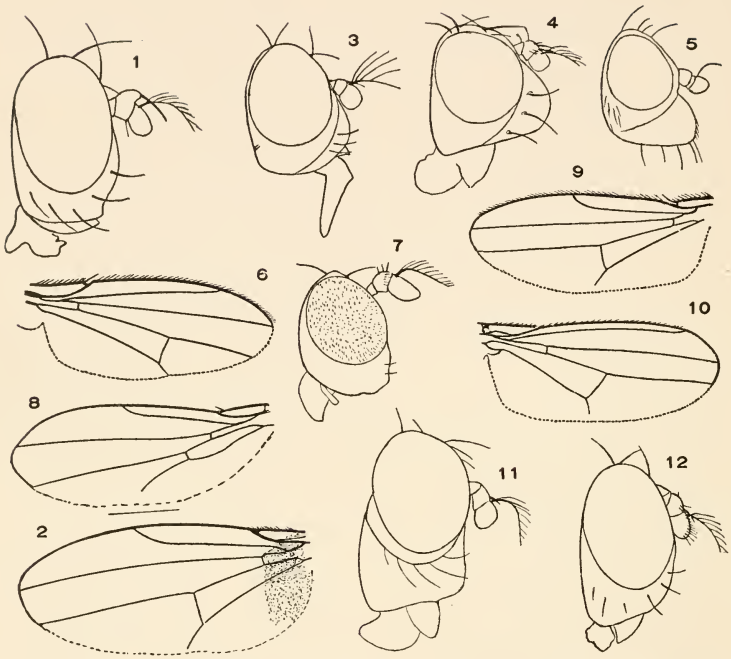


Fig. 119. Ephydridæ. *Psilopa nigra*, head; 2, *Psilopa aciculata*, wing. 3, *Allotrichoma abdominale*, head; 4, *Parephydra facialis*, head; 5, *Ephydra pygmæa*, head; 6, *Notiphila*, sp., wing; 7, *Hydrina nitida*, head; 8, *Hydrina nitida*, wing; 9, *Hydrellia parva*, wing; 10, *Ochtheroidea atra*, wing; 11, *Athyroglossa nitida*, head. 12, *Discomyza dubia*, head.

deutera argentata has a wide distribution over all of North and South America, the West Indies, Hawaiian Islands, etc. The flies of this species have the under surface of the body of a silvery, non-wetable character, enabling the insects to run about on the surface of the water. The larvæ doubtless live in the water, though not necessarily in foul water as has been thought.

The larvæ of many forms are peculiar, resembling

somewhat the rat-tailed larvæ of the Syrphidæ. The mouth, however, always has hooklets, and the 'tail' is

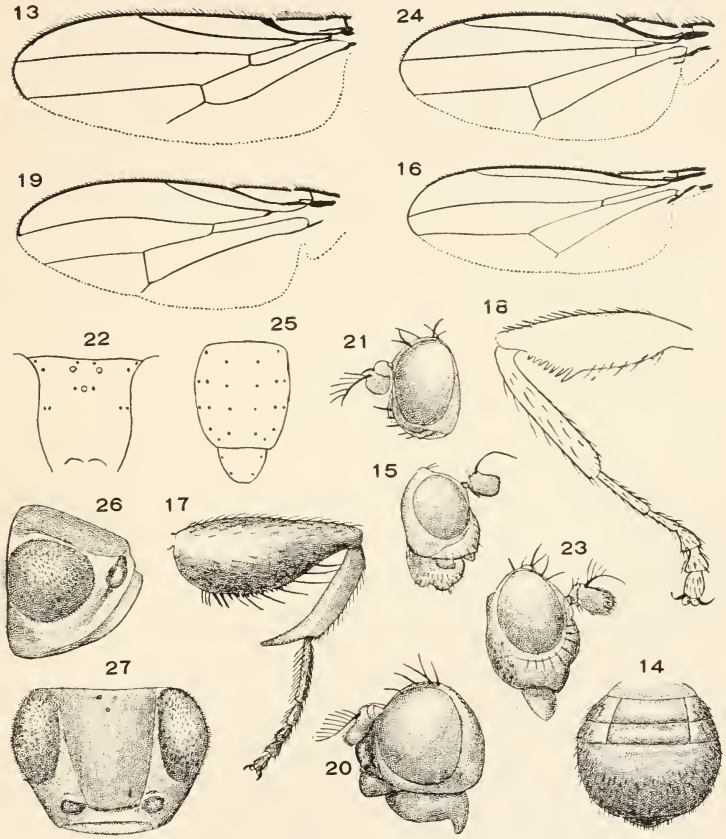


Fig. 120. Ephydridæ. 13, *Lytogaster*, sp. (Illinois), wing; 14, *Lytogaster*, abdomen; 15, *Lytogaster*, head; 16, *Ochthera*, sp. wing; 17, *Ochthera*, sp. front leg; 18, *Ochtheroidea atra*, male, front leg; 19, *Brachydeutera argentata*, wing; 20, *Brachydeutera argentata*, head; 21, *Discocerina*, sp. head; 22, *Discocerina*, sp. bristles of front; 23, *Gastrops*, sp. head; 24, *Parydra* sp. wing; 25, *Pelomyia occidentalis*, bristles of thoracic dorsum; 26, 27, *Lipochæta*, head (Coquillett).

forked at the end. The larvæ of species of *Notiphila* have been observed in the stems of water plants; those of *Hydrellia* in the sap of trees, in the parenchyma of the leaves of *Lemna*, on *Alisma*, etc., those of *Pelina*, *Ephydra*, *Parydra*, etc., in water, often salt or alkaline.

The bristly spine of the second antennal joint is sometimes not easily discernible. I have included in both sections some of the genera about which doubt may arise.

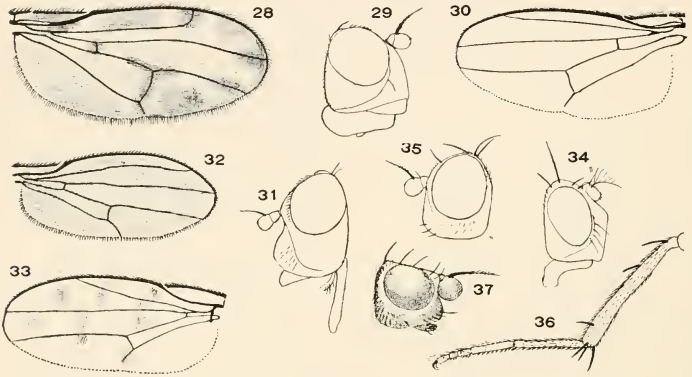


Fig. 121. Ephydridæ. 28, *Beckeriella bispinosa*, wing; 29, *Parydra bituberculata*, head; 30, *Mosillus*, sp. wing; 31, *Mosillus*, sp. head; 32, *Scatella stagnalis*, wing; 33, *Ilythea flavipes*, wing; 34, *Ilythea flavipes*, head; 35, *Pelomyia occidentalis*, head; 36, *Paralimna*, sp. middle tibia; 37, Genus ? (Illinois).

TABLE OF GENERA.

1. Second basal and anal cells complete; auxiliary vein distinct throughout; third antennal joint spherical. . . . **Canace.**
   Second basal cell confluent with discal cell; auxiliary vein coalescent distally with first vein. 2

2. Antennæ small, inserted remotely in cavities, the arista atrophied; eyes pubescent; bristleless flies (**26, 27**). . **Lipochæta.**
   Not such flies. 2

3. Second joint of antennæ with a spinous bristle at upper distal corner. 4
   Second antennal joint without such bristle. 16

4. The costal vein reaches to the tip of the third longitudinal vein. 5
   The costal vein reaches to the tip of the fourth vein. . . 6

5. Tip of male abdomen with two elongated, upwardly curved bristles; two fronto-orbital bristles present. . . **Dichæta.**
   Tip of male abdomen without such bristles; a single orbito-frontal bristle present (6). . . . . **Notiphila.**

6. Abdomen broad, nearly circular in outline; palpi broad; arista pectinate (12). . . . . **Discomyza.**
   Not such flies. 7

7. Face on upper part flat or gently convex, not carinate. . 8
   Face distinctly carinate above. 11

8. Third antennal joint longer than broad (1, 2). . **Psilopa.**
   Third antennal joint rounded, not longer than broad. . . 9

9. Front with two pairs of bristles in the middle below the ocelli, directed forward. . . . . **Paratissa.**
   Front not with such bristles. 10

10. Mouth of large size; arista pectinate. . . . **Ptilomyia.**
    Mouth small; arista bare; four pairs of strongly developed dorso-central bristles present; anal cell small but distinguishable (25, 35). . . . . **Pelomyia.***

11. Oral opening large; three or four bristles on either side of the face below. 12
    Oral opening not large. 13

12. Clypeus prominent; ocellar bristles inserted above lowermost ocellus (4). . . . . **Parephydra.**
    Clypeus small or hidden (33, 34). . . . . **Ilythea.**

13. Clypeus prominent; face gibbous below, ... 15
    Clypeus projecting but little from oral cavity. . . . 14

14. Eyes long; cheeks narrow; face feebly or not at all gibbous (21, 22). . . . . **Discocerina.**
    Eyes round; cheeks broad; face gibbous; scutellum with four bristles (3). . . . . **Allotrichoma.**

15. Arista bare; third and fourth veins gently convergent distally; head without strong bristles (30, 31). . . **Mosillus.**
    Arista pectinate; third and fourth veins not at all convergent (11). **Athyroglossa.**

* I suspect that this genus belongs with the Agromyzidæ. I have seen specimens from Massachusetts, scarcely distinguishable specifically, in which the second basal cell is complete.

16. Middle tibiæ with several long bristles on the outer side (36). **Paralimna.**
Middle tibiæ not with long bristles exteriorly. . . . 17

17. Face with a large protuberant gibbosity, below which the profile is nearly vertical; abdomen broad; legs hairy (23). **Gastrops.**
Face at most only evenly convex; legs not noticeably hairy. 18

18. Oral opening small. 19
Oral opening large. 27

19. Front femora thickened. 20
Front femora not unusually thickened. 21

20. Front femora much thickened, their tibiæ with a terminal spine; third and fourth veins convergent distally (16, 17). **Ochthera.**
Front femora moderately thickened, with spines on the under side distally, in the male at least; first posterior cell not narrowed; smaller species (18). . . . . **Ochtheroidea.**

21. Second segment of the abdomen as long as the three following together; eyes densely pubescent. . . . **Nostima.**
Second segment of abdomen shorter than the two following together. 22

22. Fourth abdominal segment unusually long and broad; arista bare; sixth vein unusually convex before the cross-vein; third antennal segment obtusely angulated above; eyes bare (13, 14, 15). **Lytogaster** Becker.*
Fourth abdominal segment not unusually long and broad. 23

23. Eyes thickly but short pubescent (9). . . . **Hydrellia.**
Eyes sparsely pubescent or bare. 24

24. Mesonotum with four strongly developed dorsocentral bristles on each side; arista bare; oral opening small; face without strong bristles (25, 35). . . . . **Pelomyia.**
Mesonotum with three or four dorsocentral bristles. . . 25

25. Sides of the face wholly without bristles. . . **Hyadina.**
Sides of the face with bristles. 26

26. Eyes wholly bare; clypeus projecting. . . . . **Pelina.**
Eyes sparsely pubescent; clypeus hidden (*Philygra*) (7, 8). **Hydrina.**

* I refer to this genus two undetermined species, one from Illinois, the other from Brazil. The face, however, is not or but feebly carinated above; the fifth segment is also large, the abdomen very convex distally.

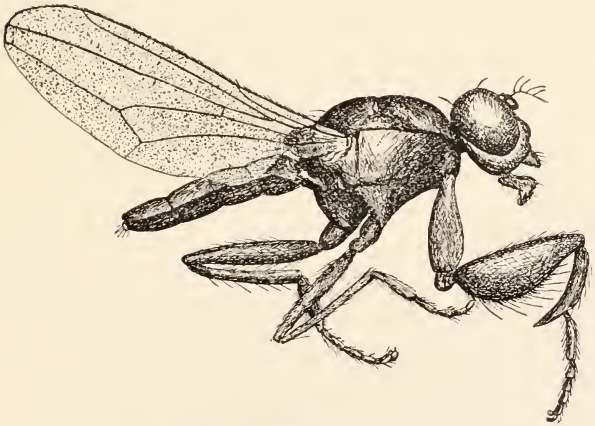
27. Clypeus prominent. 28
Clypeus hidden. 29

28. The costal vein reaches to the third longitudinal vein (**19, 20**). **Brachydeutera.**
The costal vein reaches to the tip of the fourth vein (**24, 29**). **Parydra.**

29. Claws almost straight; pulvilli indistinct (**5**). . **Ephydra.**
Claws curved; pulvilli distinct. 30

30. Oral border quite bare (**33, 34**). . . . . **Ilythea.**
Oral border bristly. 31

31. Arista pubescent (**32**). . . . . **Scatella.**
Arista pectinated. . . . . **Cænia.**



Ochthera humilis, enlarged.

XLV. Family OSCINIDÆ.

Small, bare species. Head usually hemispherical; face usually nearly vertical in profile; oral border rarely with vibrissæ; front broad, flattened, sometimes with bristles. Antennæ usually short and the third joint rounded. Genitalia hidden. Wings moderately or very short; auxiliary vein vestigial; posterior basal cell united with discal cell; posterior cross-vein sometimes wanting; anal cell vestigial or wholly absent. Legs short; femora rarely thickened; tibiæ without preapical bristle.

This family of flies is always sure to be represented by numerous specimens and species in any collection of diptera. The flies are very common, and are collected in large numbers by the sweep-net from rank growing grass and over meadow-lands. Most characteristic of the family is the absence of auxiliary vein and the posterior basal and anal cells, in these respects, however, agreeing with the Ephydridæ, from which they will usually be distinguished by their lighter colors—the Ephydrids are almost invariably black,—the smaller mouth, the usually bare arista, the occasional presence of oral vibrissæ, etc.

The larvæ of several species of *Oscinis* have been bred from wheat, oats, rye and grass stems, and *Phragmites;* the larvæ of *Siphonella* from *Cirsium*, etc. The larvæ are thick, cylindrical, with stout mouth-hooklets; the abdomen has fleshy protuberances for locomotion; the antennæ are two-jointed.

Aldrich has recently expressed the suspicion that the genus *Hippelates* is not well founded, and I am inclined to agree with him. While the presence of a hooklet at the tip of the hind tibiæ would seem decisive, yet its

presence in the genus *Ceratobarys*, and the structure of the proboscis in *Hippelates* would seem to render probable that a thorough revision of the genera of this family may eliminate some now generally accepted.

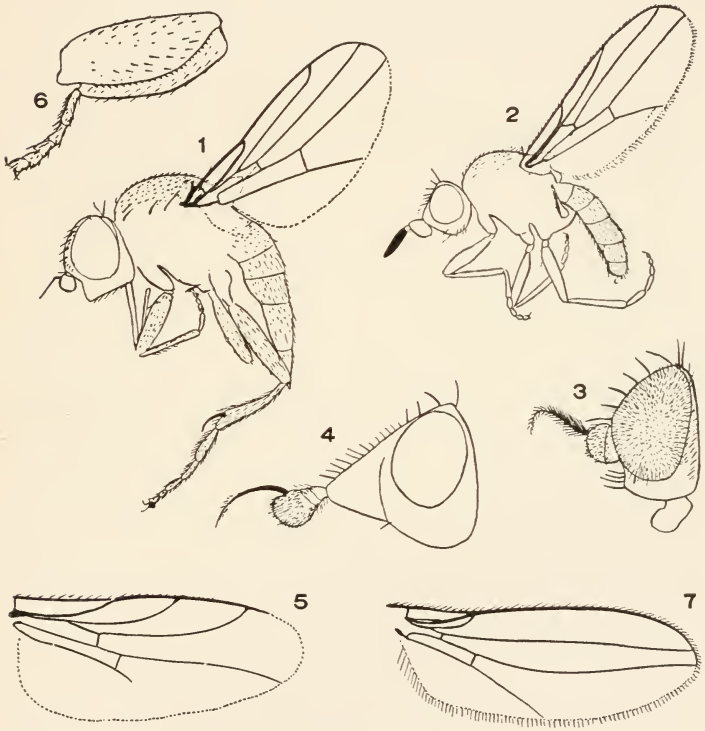


Fig. 122. Oscinidæ. 1, *Hippelates*, sp.; 2, *Elachiptera*, sp.; 3, *Gaurax anchora*, head; 4, *Eurina exilis*, head; 5, *Meromyza americana*, wing; 6, *Meromyza americana*, hind leg; 7, *Sigaloessa*, n. sp. wing (Illinois).

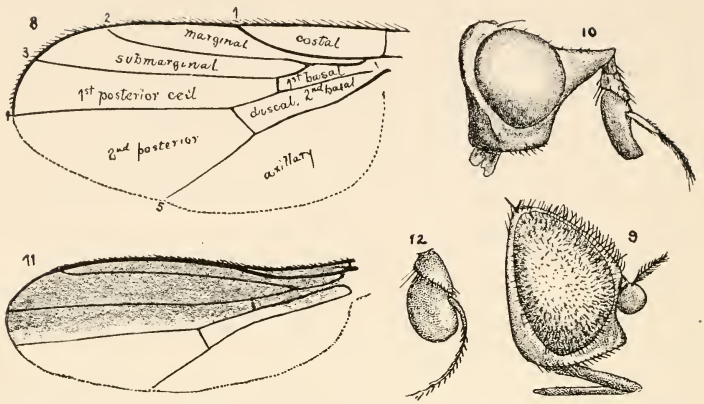


Fig. 123. Oscinidæ. 8, *Siphonella*, n. sp. venation; 9, *Siphonella*, head; 10, *Ectecephala* (?) species (Brazil), head; 11, *Ectecephala*, wing; 12, *Eurina*, sp. antenna.

TABLE OF GENERA.

1. The costal vein reaches to the tip of the third longitudinal vein or a little beyond. 10
   The costal vein reaches to the tip of the fourth longitudinal vein. 2

2. Second longitudinal vein very short, terminating in the costa near or but little beyond the insertion of the first vein. . . 3
   The second section of the costa is at least as long as the third section. 4

3. Posterior cross-vein absent. . . . . **Asteia.**
   Posterior cross-vein present (**7**). . . . . **Sigaloessa.**

4. Antennal bristle thickened, style-like. 5
   Antennal arista as usual, slender, bare, pubescent or rarely plumose. 6

5. Hind tibiæ with a curved spur at the tip on inner side. **Ceratobarys.**
   Hind tibiæ without such spur (**2**). . . **Elachiptera.**

6. Hind tibiæ with a curved spur at tip on inner side; proboscis often elongated and geniculate (**1**). . . . . **Hippelates.**
   Hind tibiæ without such spur. 7

7. Face concave in profile, the oral margin produced. . . 8
Face receding in profile, the oral margin not produced. . 9

8. Oral vibrissæ wanting; proboscis often elongated and folding (**8, 9**). . . . . **Siphonella.**
Oral margin with vibrissæ; proboscis fleshy, not folding; front with bristles (see fig. **37**, Ephydridæ. Genus new?)

9. Third antennal joint round or oval, with a bare or pubescent dorsal arista.* . . . . . **Oscinis.**
Third antennal joint more reniform, with a subterminal short-plumose arista; eyes pubescent (**3**). . . . **Gaurax.**

10. No posterior cross-vein; first three longitudinal veins curved forward. . . . . **Elliponeura.**
Posterior cross-vein present. 11

11. Head produced conically in front. 12
Head not produced conically in front. 13

12. Third antennal joint much longer than wide; eyes large; front excavated. . . . . **Ectecephala.**
Third antennal joint but little longer than wide, oval or reniform; eyes not large; front not narrowed nor excavated (**4, 12**). **Eurina.**

13. Hind femora much thickened (**5, 6**). . . **Meromyza.**
Hind femora not thickened. . . . . **Chlorops.**

* If shining black species, the face rather convex and roughened, the arista bare, compare *Mosillus*, Ephydridæ.

XLVI. Family DIOPSIDÆ.

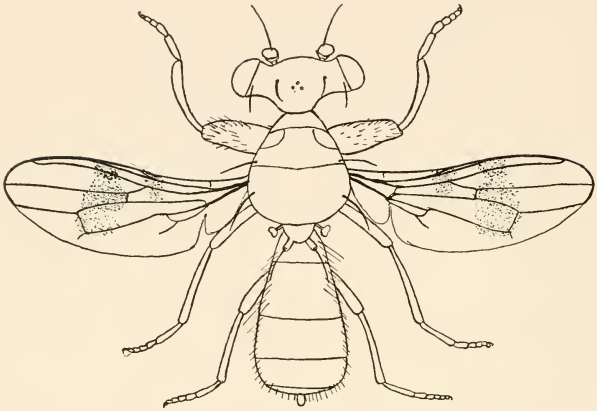


Fig. 124. *Sphyracephala brevicornis*, enlarged.

Small, bare species. Head prolonged into a lateral process on each side bearing the eye; front bristly on the upper part only; no vibrissæ on the border of the mouth. Front femora thickened. Auxiliary vein much approximated to the first longitudinal vein; discal and second basal cells confluent.

But a single species of this family, *Sphyracephala brevicornis* Say, is known from North America, and it will be easily enough recognized by the singular eye-stalks. The habits, whether of the adults or larvæ, are not known, nor are they known of any other member of the family, so far as I am aware.

XLVII. Family BORBORIDÆ.

Rather small to very small, black, brown or obscurely yellowish flies, having a quick, short flight. Head hemispherical; vibrissæ present; front broad, usually bristly. Antennæ short; third joint rounded or obtusely pointed with a dorsal or terminal, bare or pubescent arista. Wings rarely absent; auxiliary vein wanting or indistinct, never clearly separated; second basal and anal cells often incomplete or absent. Legs moderately long and strong; hind metatarsi usually dilated and abbreviated.

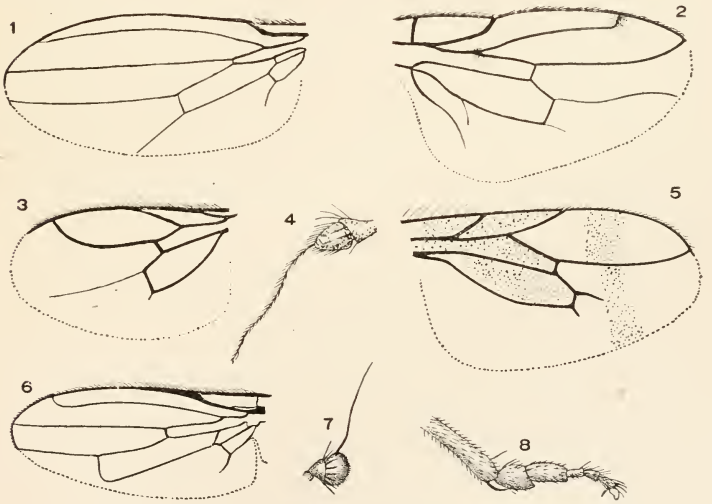


Fig. 125. Borboridæ. 1. *Sphærocera*, wing; 2, *Limosina venalicia*, wing; 3, *Limosina perparva*, wing; 4, *Limosina perparva*, antenna; 5, *Limosina lugubris*, wing; 6, *Borborus*. sp. wing; 7, *Borborus*, sp. antenna; 8, *Borborus*, sp. hind tibia and tarsus.

The flies of this family are almost invariably found about decomposing organic matter. Those belonging to *Borborus* and *Sphærocera* are observed, often in clouds, about dung and refuse, where their larvæ live. The small flies of the genus *Limosina* are seen in abundance in marshy places in company with the smaller ephydrids.

The larvæ of *Borborus* are cylindrical, with the skin roughened by erect, minute bristles; the antennæ are two-jointed, the mouth-hooklets well developed; the posterior end has conical processes near the anus, and smaller tubercles about the spiracles; in *Limosina* the hind stigmata are tube-like. The larvæ of *Limosina* live in fungi, algæ, diseased potatoes, and perhaps water.

TABLE OF GENERA.

1. Wingless species, ... **Aptilotus.**
   Wings fully developed. 2

2. Fourth and fifth longitudinal veins incomplete or obsolescent beyond the discal cell; second basal cell incomplete (**2, 3, 4, 5**). **Limosina.**
   Fourth vein at least, fully developed; second basal and the anal cells complete. 3

3. Scutellum with well-developed bristles; fifth vein incomplete beyond discal cell; metatarsi shorter than second joint (**6, 7, 8**). **Borborus.**
   Scutellum without bristles; fifth vein complete (**1**). **Sphærocera.**

XLVIII. Family PHYCODROMIDÆ.

Mesonotum, scutellum and abdomen flat. Front bristly; cheeks and face bristly, the vibrissæ indistinctly differentiated. Legs stout, all the tibiæ spurred and with a preapical bristle on the outer side; metatarsi not abbreviated; terminal joint of all the tarsi incrassate and with stout claws. Venation complete; auxiliary vein distinct in its entire course; costa without bristles; basal cells not very small.

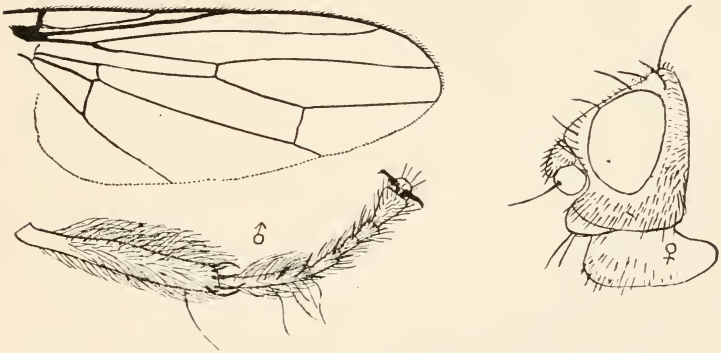


Fig. 126. Phycodromidæ. *Cælopa*, wing, head, and front tibiæ and tarsus of male.

But two genera of this family are known from North America. Species of the genus *Cælopa* are observed, often in abundance, among sea-weeds thrown up by the waves along the sea-shore. Recently Mr. Coquillett has added another genus, *Omomyia*, from California (Canadian Entomologist, 1907, p. 76), differing from *Cælopa* in having the scutellum nearly one-half as long as the mesonotum, distally subtruncated, bare, and with two pairs of lateral bristles. The habits of the type species (*O. hirsuta*) are not given.

XLIX. Family HETERONEURIDÆ.

Head broad, subhemispherical. Face short, nearly vertical; vibrissæ present. Front broad, bristly to or nearly to the root of the antennæ. Ocellar bristles usually present; postvertical bristles divergent. Antennæ porrect; first two joints short, the third usually rounded; arista bare, pubescent or short plumose. Proboscis short; palpi rather broad. Body more or less elongate. Legs rather long and slender; tibiæ with or without a preapical bristle. Venation complete; basal cells small; first longitudinal vein short, the auxiliary narrowly separated from it; sixth vein not reaching the wing margin.

The members of this small family of rather small flies are to be found throughout the summer in shady places by the sides of brooks, or in the forests about the trunks of decaying trees; in damp meadowy places among the grass; on leaves, etc.

Larvæ of this family have been found in decaying wood, under bark of trees, etc. They are slender, cylindrical, slightly thickened posteriorly, white in color. The mouth hooklets are very small, the body segments not distinctly separated; abdominal segments with a transverse swelling for locomotion. The larvæ have the power of leaping as have those of *Piophila*. The act is performed by fixing the mouth hooklets in the two chitinous, straight or curved hooklets on the upper side of the last segment and then suddenly releasing them. The puparia are yellowish, ellipsoidal and with two horns on the last segment as in the larvæ.

Mr. Czerny has attempted recently to break up the genus *Heteroneura*, using for generic characters the bristles of the front chiefly. I gravely doubt whether all

his genera will be found valid eventually. *Heteringomyia* he diagnoses as differing from *Heteroneura* in the absence of cruciate bristles (a pair of small bristles toward the middle of the lower part of the front) and the absence of preapical bristle on the tibiæ. *H. flavipes*, *lumbalis* and *valida* lack the cruciate bristles, but one of them, (*H. lumbalis*) has a distinct preapical bristle, so that this character is rendered invalid, or the cruciate bristle char-

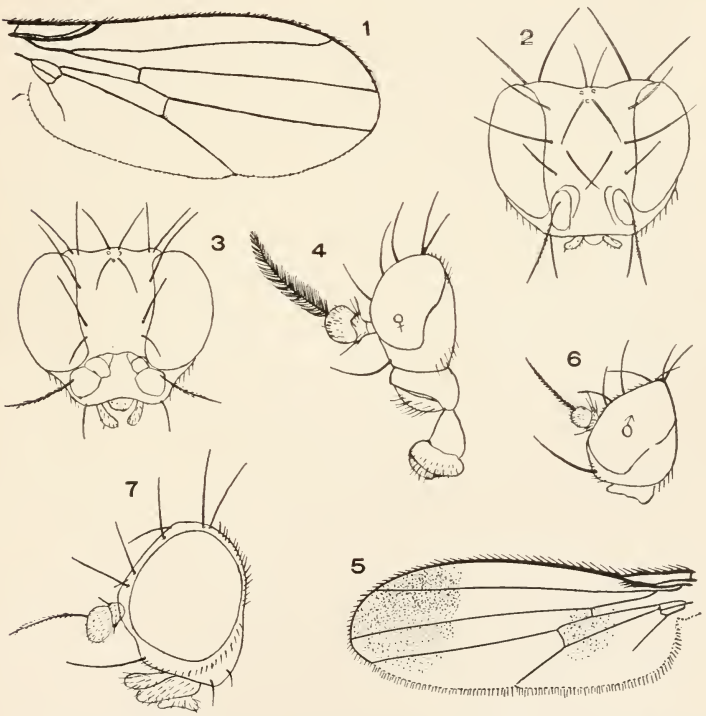


Fig. 127. Heteroneuridæ. 1, *Heteroneura*, wing; 2, *Heteroneura*, head from in front showing arrangement of bristles (Czerny); 3, *Heteringomyia*, head from in front showing arrangement of bristles (Czerny); 4, *Chætoclusia*, head; 5, *Chætoclusia*, wing; 6, *Heteroneura*, head; 7, *Clusia*, head (Czerny).

acter; which I leave for Mr. Czerny to decide. His genus *Hendelia* he distinguishes from *Heteroneura* by the absence of the post-vertical bristles, and the more remote insertion of the antennæ from each other. Mr. Coquillett has added another, based chiefly on the absence of both postvertical and cruciate bristles. Still another from South America (fig. 6) differs in the arrangement of these bristles. Possibly such a division of the species is natural, but I am yet to be convinced that it is. I omit the preapical bristle character in the table, since that, at least, seems worthless, as was observed long ago by Loew.

TABLE OF GENERA.

1. Cross veins approximated, the penultimate section of the fourth vein not more than one fourth the length of the ultimate section. 2

   Cross veins not approximated; the penultimate section of the fourth vein at least one-third the length of the ultimate section (7 and p. 80, 16.) . . . . . **Clusia.**

2. Postvertical, ocellar and cruciate bristles distinct (*Clusiodes* Coq.) (1, 2). . . . . **Heteroneura.**

   Post-vertical and ocellar bristles present, the cruciate absent (3). **Heteringomyia.**

   Postvertical and cruciate bristles absent, the ocellar obsolescent; distal end of first vein bristly (4, 5). . . **Chætoclusia.**

For *Peratochætus ornatus*, see Geomyzidæ (*Spilochroa.*)

L. Family SCIOMYZIDÆ.

Fig. 128. *Tetanocera umbrarum*, enlarged.

Head short*, as broad or broader than the thorax; face more or less retreating; mouth without vibrissæ at its border, the margin angular. Abdomen composed of six segments, rather long and narrow. Wings longer than the abdomen; auxiliary vein present, distinctly separated from the first longitudinal vein; posterior basal cell and the anal cell complete. Legs rather long; preapical tibial bristle present.

* The genus *Trigonometopus* will be brought here by the family table. It has been variously referred to the Heteroneuridæ, Sciomyzidæ, Ortalididæ, Sapromyzidæ by authors. It will be recognized by itsprojecting head and very retreating face.

The members of this family are usually found in meadows, along the banks of small streams, etc., wherever it is moist. They are, for the most part, brown or brownish yellow in color, oftentimes with pictured wings. They are slow in their habits. The larvæ are slender, cylindrical, thin anteriorly; the last segment with six or eight conical, fleshy tubercles. They are aquatic.

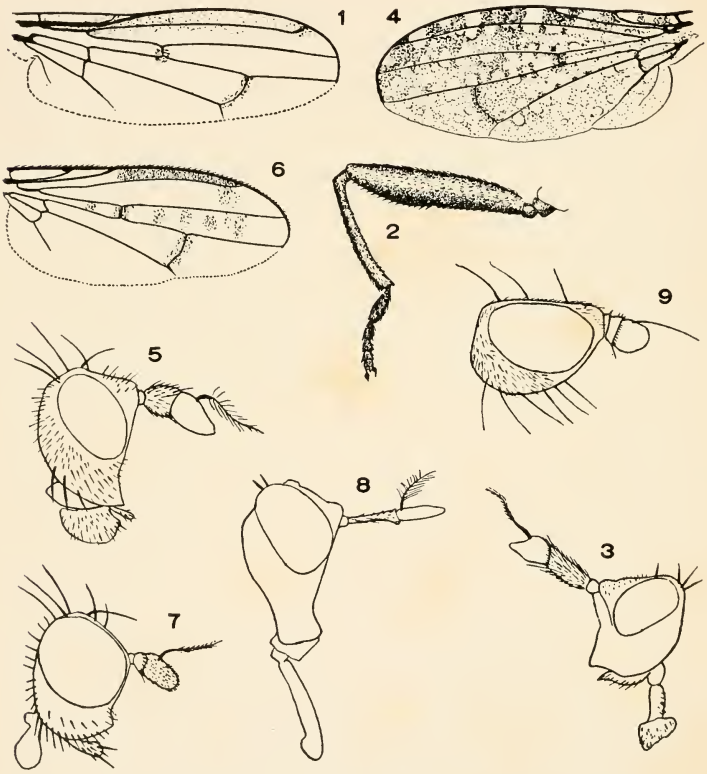


Fig. 129. Sciomyzidæ. 1, *Sepedon*, wing; 2, *Sepedon*, hind leg; 3, *Sepedon*, head; 4, *Tetanocera*, wing; 5, *Tetanocera*, head; 6, *Sciomyza*, wing; 7, *Sciomyza*, head; 8, *Thecomyia*, head; 9, *Trigonometopus*, head.

TABLE OF GENERA.

1. Second joint, at least, of antennæ short. 2
   Antennæ elongated. 8

2. Face excavated, the oral margin protuberant. 4
   Face retreating in profile, but little or not at all excavated; oral margin but little or not at all prominent. 3

3. Head strongly projecting forward (9). . **Trigonometopus.**
   Head not at all projecting (7). . . . . **Sciomyza.**

4. Cheeks broader than the long diameter of the eyes; oral border moderately protuberant; costa somewhat spinose. **Actora.***
   Cheeks not broader than the long diameter of the eyes; oral margin very prominent; costa bare. 5

5. Clypeus prominent. 6
   Clypeus not prominent. 7

6. Scutellum with four bristles on its border. . **Neuroctena.**
   Scutellum with six bristles (p. 80, 17, 18). . **Heterocheila.**

7. Front tibiæ with a preapical bristle. . . . **Bischofia.**
   Front tibiæ without preapical bristle. . . . **Dryomyza.**

8. Hind femora long; second antennal joint much elongated, longer than the third. 9
   Hind femora only moderately elongated and but little thickened; second antennal joint as long or a little shorter than the third (5). . . . . **Tetanocera.**

9. Hind femora thickened; face not produced downward (1, 2, 3). **Sepedon.**
   Hind femora not thickened; face much produced downward (8). **Thecomyia.**

* Of doubtful occurrence in North America.

LI. Family HELOMYZIDÆ.

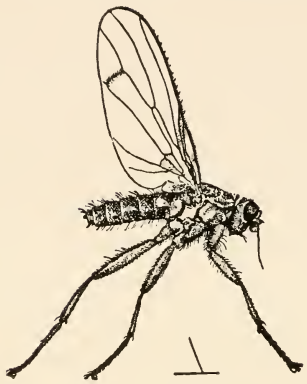


Fig. 130. *Leria pubescens*, enlarged. After Washburn.

Face nearly vertical, or retreating, with oral vibrissæ; front bristly on the posterior half only; antennæ short. Abdomen rather broad and long, composed of six segments; male genitalia somewhat prominent. Wings comparatively large; all the basal cells distinct; costa usually bristly; first longitudinal vein bare. Tibiæ with spurs and preapical bristle.

The flies of this rather small family are found in grassy, shady and damp places, on windows, etc. They feed upon decaying animal or vegetable substances, fungi, excrement, etc. Many species live in caves and burrows. The larvæ of *Leria* have been bred from bat and rabbit dung; those of *Helomyza* from truffles, decaying wood, etc. They are cylindrical, obtuse behind, more pointed in front; the antennæ are situated upon long conical processes; mouth hooklets large and pointed; the seven

abdominal segments on each side in front widened, below with bristly pseudopods.

For *Curtonotum*, a genus with pectinate costa, see Drosophilidæ.

Fig. 131. *Scoliocentra helvola*, enlarged.

TABLE OF GENERA.

1. A humeral bristle present. 2
   No humeral, no propleural bristle. . . . . **Helomyza.**
2. No bristle above base of front coxæ (propleural). **Allophyla.**
   A bristle above base of front coxæ. 3
3. Spurs of middle tibiæ curved (**3** and fig. 131). **Scoliocentra.**
   Spurs of middle tibiæ not curved. 4
4. Face much retreating in profile, the anterior oral border obliterated; four dorsocentral bristles present (**2**). **Anorostoma.**
   Face not conspicuously retreating. 5

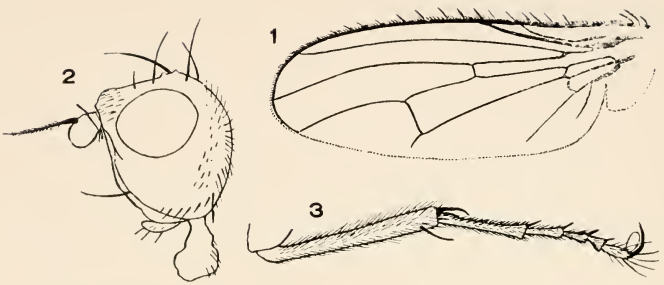


Fig. 132. Helomyzidæ. 1, *Leria*, sp. wing; 3, *Anorostoma*, head; 5, *Scoliocentra helvola*, middle tibia and tarsus.

5. Eyes very small; four dorsocentral bristles; arista very long. 6
   Eyes not very small. 7

6. All the tibiæ without bristles on outer side; hind femora of male often emarginate at base below. . **Eccoptomera** Loew.
   Middle tibiæ at least with bristles on outer side. . **Oecothea.**

7. Four pairs of dorsocentral bristles. 8
   But three pairs of dorsocentral bristles; third antennal joint short; bristles of costa small. . . . . **Tephrochlamys.**

8. Costal border of wings noticeably bristly (fig. 130). . **Leria.**
   Costal border with very small bristles. . . **Heteromyza.**

LII. Family CORDYLURIDÆ.

Fig. 133. *Scatophaga furcata*, enlarged; after Washburn.

Squamæ small, the upper one concealing the lower. Head seldom longer than high; eyes rounded or oval, bare, broadly separated by the front in both sexes; front almost always with well-developed bristles. Wings rather large; auxiliary vein always present and distinct; first longitudinal vein never much shortened, where it joins the costa never with bristle; basal cells rather large, always complete; first posterior cell seldom narrowed in the border or closed; abdomen with more than four visible segments.

Some of the flies of this group are easily confounded with those of the Anthomyidæ, but an attentive examination of the squamæ, the number of segments of the abdomen and costa will usually resolve doubt of their correct location. The flies are often of considerable size for Acalypterates, never very small.

The family has been called the Scatomyzidæ by Becker, who has thoroughly studied and monographed the Eu-

ropean forms. But there is reason in the objection to the use of a term derived from a generic name which is clearly a synonym. The name Cordyluridæ, applied by Loew, is the oldest name otherwise, and must take precedence over Scatophagidæ, which some authors have used. Many of the new genera erected by Becker have been

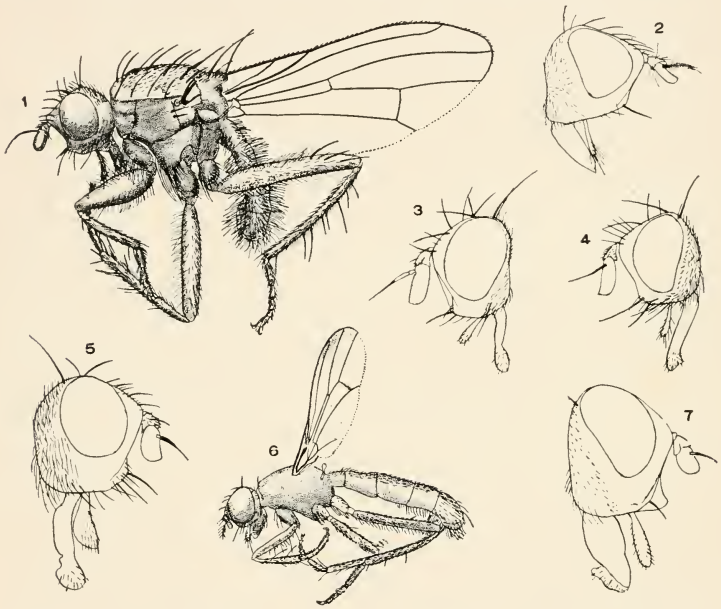


Fig. 134. Cordyluridæ. *Scatophaga*, male; 2, *Acicephala polita*, head; 3, *Pselaphephila similis*, head; 4, *Orthochæta* (?) *gilvipes*, head; 5, *Spathiophora*, sp. head; 6, *Parallelomma varipes;* 7, *Hydromyza confluens*, head.

recognized in North America within recent years, and doubtless others will be, since the family has received comparatively little study with us. For further study of the group, the reader is advised to procure his paper. I give only such genera in the following table as have been authoritatively recognized from North America, the

characters drawn chiefly from Becker's table. Many of the flies, especially those of *Scatophaga*, are frequently found about excrement; some feed upon other insects which they capture. Many species of *Cordylura* and their allies are collected in meadowlands and moist places. The larvæ of some live in the stems of plants and some, it is said, have been bred from the larvæ of *Noctua*.

TABLE OF GENERA.

1. Prothoracic and stigmatic bristles absent; thorax with five dorsocentral bristles, or, if fewer, the palpi broad; at least four scutellar bristles present; wings usually long. . . . 2
   Prothoracic and stigmatic bristles present usually; when absent the thorax usually nearly bristleless; one to three sternopleural bristles present; one to five dorsocentrals, the scutellum with from one to four. 3

2. Moderately large to small species; males more thickly haired than the females; face but little excavated in profile; third antennal joint rounded, with a bare or plumose arista; palpi long and slender; five dorsocentrals present (**1**, and fig. 133).
   Scatophaga.
   Head broad; palpi more or less dilated. 9

3. Front femora on the inner side with a double row of bristles. 13
   Front femora at the most with a single row of bristles. . 4

4. Palpi small, slender. 5
   Palpi long, flattened, leaf-like; eyes oval; antennæ long, the distal end angular; abdomen not noticeably short (**3**).
   Pselaphephila.

5. Palpi with a long, terminal bristle; one sternopleural bristle; arista plumose or strongly pubescent; costa of wings hairy or pectinated; third vein straight or gently curved. . . . 6
   Palpi not with long terminal bristle—one to three sternopleural bristles present. 8

6. Arista plumose; femora and tibiæ with strong bristles; five dorsopleural bristles; usually shining black species. . . . 7
   Antennal arista slender, scarcely thickened at its base, short or long haired; femora and tibiæ long and slender, and but little bristly; from one to five dorsocentrals; yellow and black species.
   Parallelomma.

7. Head noticeably longer than high; face much retreating (2). **Acicephala.**
   Head scarcely longer than high; face gently retreating in profile. **Cordylura.**

8. One sternopleural bristle; eyes but little higher than broad; antennæ as long as the face; oral margin with but one, anteriorly directed principal bristle on each side; arista distinctly haired; five dorsocentrals; moderate sized, shining yellow flies. **Megophthalma.**
   Two sternopleural bristles: antennæ as long as the face, third joint rounded, strongly pubescent; hind tibiæ with two pairs of bristles on outer side; shining black, small species. **Hexamitocera.**
   Three sternopleural bristles; five dorsocentrals; arista distinctly hairy; four scutellar bristles; hind tibiæ with three pairs of bristles; moderate sized, thickly hairy, gray flies. **Orthochæta.**

9. Eyes and head round; five dorsocentral bristles. . . . 10
   Eyes and head oval, higher than long; a single dorsocentral bristle; cheeks broad; proboscis thick and swollen; oral border with one short bristle on each side; antennæ short, distally rounded; abdomen flat; hypopygium only a little prominent; rather large; bare, ashy gray flies (7). . . . . **Hydromyza.**

10. Front tibiæ on the inner side with a short, rectangular spine in addition to the terminal bristles. . . **Acanthocnema.**
    Front tibiæ without such bristle; male hypopygium with long tufts of hairs; third antennal joint somewhat elongated; with a sharp, upper distal angle; oral border with many thickly standing bristles. . . . . **Pogonota.**
    Front tibiæ without such bristles; male hypopygium without long tufts. 11

11. Third antennal joint rounded anteriorly; eyes somewhat obliquely oval; cheeks small; face very short; oral border with a single bristle on each side; proboscis thickened; legs but little bristly; femora somewhat thickened. . . . **Microprosopa.**
    Third antennal joint with a sharp anterior angle. . . 12

12. Acrostical bristles in more than two rows; thorax and legs thickly haired; bristles of oral border numerous; femora strong, with fine hair and weak bristles; cheeks broad (5). **Spathiophora.**
    Acrostical bristles in two rows; mesonotum and legs sparsely and not long haired; antennæ small, with sharp tip; cheeks not broad; oral border with bristles on each side; small, short, gray-dusted flies (*Chætosa*, *Opsiomyia*). . **Tricopalpus.**

13. Under side of head with about ten bristles. . **Plethochæta.**
    Under side of head with about four bristles. . **Pycnoglossa.**

LIII. Family ANTHOMYIDÆ.

Fig. 135. *Spilogaster*, species; enlarged.

Small to moderately large flies, often resembling the common house-fly, usually non-metallic in color. Antennal arista plumose, pubescent or bare; eyes hairy or bare; males often holoptic, sometimes broadly dichoptic, the females always dichoptic; abdomen composed of four or five segments; the male genitalia often with subanal appendages; first posterior cell of wings broadly open; bristles of body often weak; squamæ usually of considerable size.

The above definition will, in most cases, distinguish the members of this large family of inconspicuously colored flies. Its limits, however, are not sharp; with the true muscids it is connected by *Muscina* and allied forms; with the Cordyluridæ by *Fucellia*, etc. When one has become tolerably well acquainted with the allied fami-

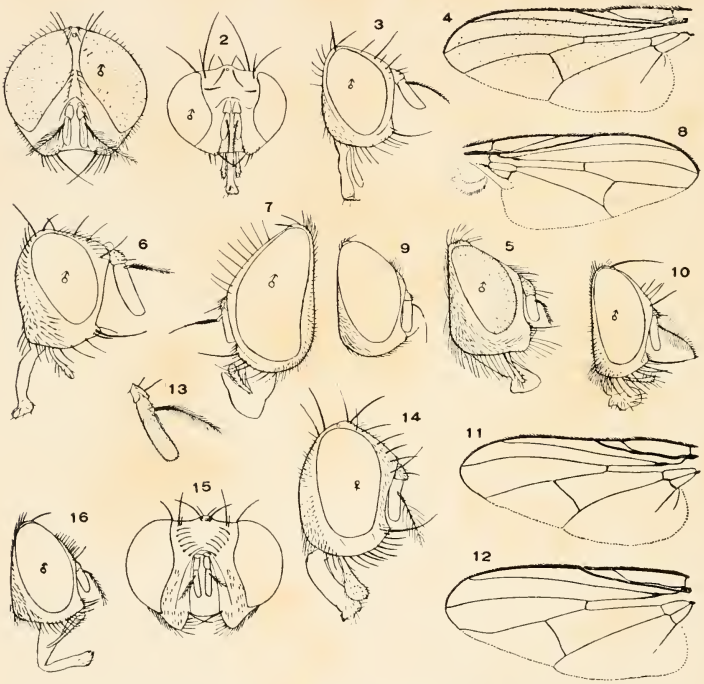


Fig. 136, Anthomyidæ. 1, *Hyetodesia* (*Phaonia*) *lucorum*, head, from front; 2, *Schœnomyza chrysostoma*, head, from in front; 3, *Cœnosia cinerea*, head; 4, *Lasiops spiniger*, wing; 5, *Lasiops spiniger*; head; 6, *Phyllogaster cordyluroides*, head; 7, *Homalomyia* (*Fannia*) *scalaris* head; 8, *Homalomyia scalaris*, wing; 9, *Ophyra aenescens*, head; 10, *Spilogaster*, species, head; 11, *Spilogaster*, wing; 12, *Leucomelina*, species, wing; 13, *Leucomelina*, antenna; 14, *Lispa uliginosa*, head; 15, *Lispa*, species, head from in front; 16, *Limophora exul*, head.

lies, he will seldom be much in doubt as to the proper location of his specimens here. The contiguity of the male eyes, together with the open first posterior cell and large squamæ, is always decisive. Not a few of the species are common about houses, outbuildings, etc., and some of them are among the worst enemies to garden vegetables that the agriculturist has to contend against.

In the larval stage, the great majority of the species are vegetable feeders, either in living or decaying material. The larvæ of species of *Spilogaster*, *Hydrotæa*, *Hylemyia* and *Cœnosia* have been found in dung or manure; those of *Hydrotæa*, *Ophyra*, *Anthomyia*, *Homalomyia*, etc., in decaying vegetable material; those of *Hylemyia*, *Anthomyia*, *Homalomyia*, etc., in the nests of various hymenoptera; those of *Mydæa* in *Spermophila* and *Mimus*. Larvæ of various species of *Phorbia* are very destructive to growing radishes, onions, cabbage, etc., feeding upon the roots. The larvæ are either slender and cylindrical, or flat and oval, with four rows of thread-like processes on the segments. Both types are amphipneustic, and are always provided with two chitinous mouth-hooklets. The puparium is oval in the smooth cylindrical forms, flattened in the others.

Squama and antisquama, or tegula and antitegula, are the terms proposed by Osten Sacken to indicate respectively the lower and upper scales.

TABLE OF GENERA.

REVISED BY PROF. C. F. ADAMS.

1. Front narrow in the male, not more than one-fifth of the width of the head; often holoptic or subholoptic. 2
   Front in both sexes wide, including at least one-fourth of the width of the head in the male. 27

2. Squama larger than the antisquama. 3
   Squama and antisquama of nearly equal size, neither large. . 17

3. Proboscis projecting, horny, the labella slender and pointed, turned backward, hook-like; arista pubescent; eyes bare; moderate sized, blackish species. . . . . **Drymeia.**
Proboscis not horny and hook-like. 4

4. Abdomen of male ovate or conical; second segment not longer than the third, the first segment usually imperceptible. . . 5
Abdomen of male elongate, the second segment longer than the third; first segment usually distinctly visible. . . . 12

5. Eyes pilose (1) (*Phaonia*). . . . . **Hyetodesia.**
Eyes bare. 6

6. Arista plumose. 7
Arista bare or pubescent. 8

7. Abdomen ovate, not spotted. . . . . **Mydæa.**
Abdomen subconical, usually spotted (**10, 11**, fig. 135.). **Spilogaster.**

8. Front femora of the male with tubercles or emarginations below, or otherwise peculiarly constructed; front tibiæ often with emarginations; hind femora often arcuate; middle and hind tibiæ sometimes with tufts of hairs; black or blue-black flies, often pollinose. . . . . **Hydrotæa.**
Front femora simple in both sexes. 9

9. Abdomen shining black or metallic black (**9**). . **Ophyra.**
Abdomen not shining black or metallic, and with markings. 10

10. Vibrissæ at some distance above oral margin. **Brachyophyra.**
Vibrissæ inserted at oral margin. 11

11. Fourth vein nearly or quite straight (**16**).* . **Limnophora.**
Fourth vein distinctly curved forward (**12, 13**). **Leucomelina.**

12. Eyes pilose. . . . . **Trichophthicus.**
Eyes bare. 13

13. Anal cell short; axillary vein roundly curved toward it (**7, 8**). **Homalomyia.**
Anal vein long, often reaching the wing margin. . . 14

14. Arista plumose (**28, 29**). . . . . **Hydrophoria.**
Arista bare or pubescent. 15

15. Oral margin and under side of head thickly clothed with bristly hairs. . . . . **Pogonomyia.**
Not thickly covered. 16

* Compare *Hammomyia*.

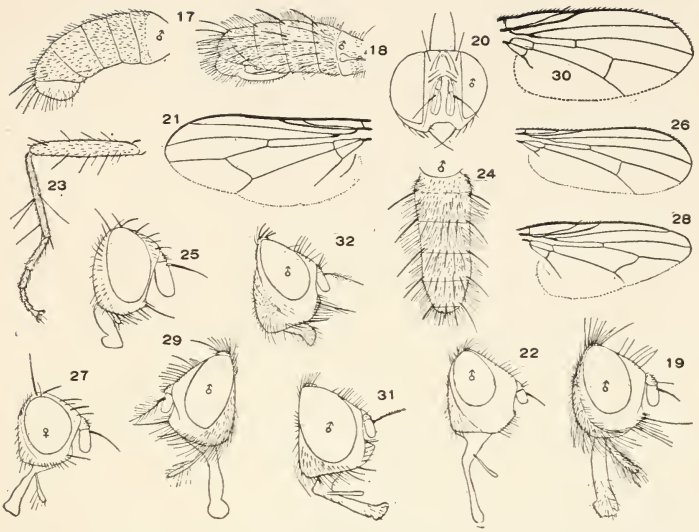


Fig. 137. Anthomyidæ. 17, *Pentacricea aldrichi*, abdomen; 18, 19, *Eremomyia humeralis*, abdomen and head; 20, *Dexiopsis lacteipennis*, head from in front; 21, 22, *Hammomyia unilineatas*, wing and head; 23, *Caricea insignis*, leg; 24, *Phorbia brassicæ*, abdomen; 25, *Tetrachæta unica*, head; 26, *Hoplogaster nigritarsis*, wing; 27, *Pogomyia bicolor*, head; 28; 29, *Hydrophoria divisa*, wing, head; 30, *Choristoma pokornyi*, wing; 31, *Anthomyia radicum*, head; 32, *Hylemyia setiventris*, head.

16. Proboscis slender, nearly as long as the thorax. **Dolichoglossa.**
    Proboscis not unusually long (**31**). . . . **Anthomyia.**
17. Eyes pilose (**4, 5**). . . . . **Lasiops.**
    Eyes bare. 18
18. Arista plumose. 19
    Arista bare or pubescent. 20
19. Front prominent, without white spots above antennæ; male without subanal appendages; female without decussating bristles in front of ocelli; body (except in *vittipes*) marked with shining black stripes or spots. . . . . **Eustalomyia.**
    Front not prominent; males usually with subanal appendages; female usually with cruciate bristles in front of ocelli; body without shining black stripes or spots (**32**). . . **Hylemyia.**
20. Abdomen of male subcylindrical. 21
    Abdomen long, depressed. 25
21. An additional macrochæta above the first posthumeral (**18, 19**). **Eremomyia.**
    Without such macrochætæ, or with a bristly hair instead. . 22

22. Sides of face and cheeks wide; front of female narrower than either eye; wings without costal spine (21, 22) **Hammomyia.**
Either the sides of the face or the cheeks narrow; front of female often wider than eye; wings usually with costal spine. 23

23. Legs wholly or partly rufous or yellow (27). . **Pegomyia.**
Legs wholly black. 24

24. The anal vein attains the wing margin. . . **Chortophila.**
The anal vein does not reach the wing margin. . . **Azelia.**

25. The eyes occupy the upper two-thirds of the sides of the head. 26
The eyes do not occupy the upper two-thirds of the sides of the head (24). . . . . **Phorbia.**

26. The anal vein reaches the wing margin. . . **Prosalpia.**
The anal vein does not reach the wing margin. . **Cœlomyia.**

27. Anterior cross-vein situated before the end of the first vein. 28
Anterior cross-vein under or beyond the end of the first vein. 30

28. Wings without costal spine. 29
Wings with costal spine (30). . . . . **Choristoma.**

29. Squamæ small, equal. . . . . **Euryomma.**
Squamæ large, the under longer than the upper. **Charadrella.**

30. Palpi unusually broad at tip (14, 15). . . . . **Lispa.**
Palpi not unusually enlarged at tip. 31

31. Squamæ equal (2).* . . . . . **Schœnomyza.**
Squamæ unequal, the lower projecting beyond the upper. 32

32. Head narrow, antennæ not elongate; tibiæ with very long bristles (23). . . . . **Caricea.**
Not having all the above characters. 33

33. Four post sutural macrochætæ (25). . . . **Tetrachæta.**
With less than four post sutural macrochæta. . . . 34

34. Five abdominal segments visible (17). . . **Pentacricia.**
Only four abdominal segments visible. 35

35. Abdomen cylindrical, incrassate posteriorly; hypopygium prominent (6). (Compare *Hoplogaster* 26). **Phyllogaster.**
Abdomen not cylindrical or incrassate behind. . . . 36

36. Head much broader than high (20). . . . **Dexiopsis.**
Head not markedly broader than high. 37

37. Frontal triangle large, with straight sides, the apex blunt, reaching the base of the antennæ. . . . . **Limnospila.**
Triangle with concave sides, the apex sharp, seldom reaching the base of the antennæ (3). . . . . **Cœnosia.**

* **Fucellia.** The members of this genus, which has been referred to various families of acalyptrates, are found often in abundance along sea-shores, about decomposing material which has been thrown up by the waves. They are of moderate size, blackish gray in color, and will be easily recognized in the males by the hind femora having a bunch of bristles near their base, inserted on a short emargination; the face has numerous vibrissal bristles; the arista is bare, etc. W.

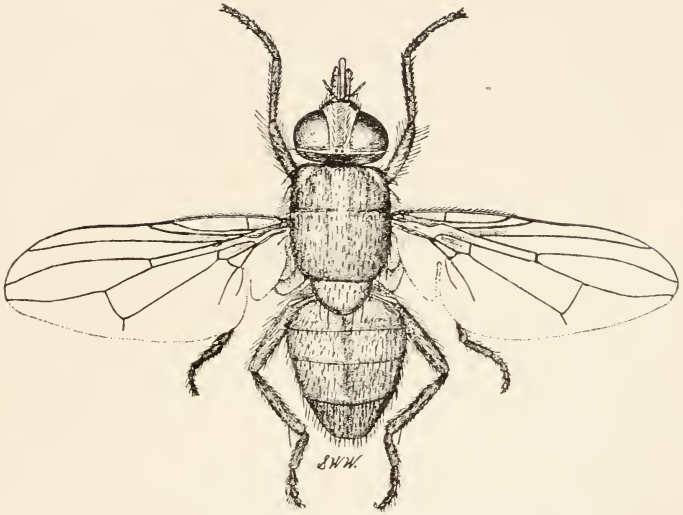


Fig. 138. *Hæmatobia serrata*, male; enlarged.

Rather small to moderately large, never elongate, thinly hairy or bare flies. Antennal arista plumose to the tip; sometimes above only, and rarely bare, in which cases the absence of bristles on the abdomen, except at the tip, together with the narrowed first posterior cell, characters distinctive of the group, will distinguish the flies belonging here from their allies. Eyes of the male approximated or contiguous; front of female broad. Eyes bare or hairy. Abdomen composed of four visible segments. Genitalia not prominent.

Like the Sarcophagidæ, the species and individuals of this family are common everywhere. The common housefly, the type of the group, has a cosmopolitan distribu-

tion wherever man exists. Other species, which are scarcely less common and widely distributed, are the common blue-bottle and blow-flies, members of the genera *Lucilia* and *Calliphora*. As widely known are the stable-fly or cattle-fly, *Stomoxys*, and the horn-fly, *Hæmatobia*.

The larvæ of the house-fly live, for the most part, in dung or manure, but will thrive in almost any kind of filth; I have reared them from the decaying material in the bottoms of spittoons filled with tobacco. The female lays about one hundred and twenty-five eggs, which hatch in one or two days, according to the weather. The larvæ attain their full development in from four to seven days, and then, crawling into some secluded place, transform into pupæ, from which they emerge in about six days as mature insects, those of the autumn broods remaining over winter as puparia. In partially secluded spots the mature fly will sometimes survive the winter. The cluster-fly, *Pollenia rudis*, is yet more remarkable in this last respect. Often in early spring, or even during mild days of the winter they may be observed crawling about over the snow in numbers. They are stupid and slow and have received the name of cluster-flies from their habit of congregating in clusters about dwellings. They resemble a blow-fly somewhat; but will be distinguished by the presence of short, depressed, sparse light-colored hairs on the thorax. The larvæ of species of *Calliphora*, especially of *C. vomitoria*, are better known, perhaps, than those of any other insect. They are the common blow-fly maggots of fresh and decaying meats and vegetables. The cooking of corned beef or turnips or cabbages during warm weather is sure to attract numbers of these insects, which are quite noticeable for their loud humming and headlong flight. In the arid regions of northern Wyoming the writer has seen them in extra-

ordinary numbers, many miles from the nearest human habitation. Either their eggs or the newly hatched larvæ are deposited upon meats, and only a day or two is sufficient to transform the material into a creeping mass of disgusting maggots. The larvæ of species of this genus sometimes have habits similar to those of the screw-worm flies. The blue-bottle and green-bottle flies have habits identical with those of *Calliphora*, but they are not so common. The screw-worm fly (*Chrysomyia macellaria*), an insect common over nearly all of North and South America, is bright shining green or golden green in color, but will be distinguished from the blue-bottles by the presence of blackish stripes on the thorax. It deposits eggs, which hatch almost immediately, in decomposing matter, as do other members of the family, but it will also lay them in the ulcers of cattle, or wounds, or at the orifice of the human nose, especially when attracted thereto by a fetid breath. The larvæ in these cases quickly penetrate within the nasal and frontal sinuses, sometimes to the number of a hundred or more, quickly producing fever, extended ulceration and in frequent cases, death. These cases of Myiasis, as the affection is called, are not very frequent in North America, but have been not seldom recorded from South America. *Sarcophila Wohlfahrti*, a European species, has similar habits.

The group Stomoxyinæ includes about thirty known species, all blood-sucking in habit, among which are the notorious stable-flies, horn-flies and tsetse flies. The horn-fly (*Hæmatobia serrata**) is a comparatively recent

* Speiser, and, following him, Bezzi would call this genus *Siphona*, a name hitherto applied to a genus of proboscideous Tachinidæ, claiming that the type was *H. serrata* (*irritans*); but I quite agree with Austen that the case is by no means proven, and, even if it were, I do not think it calls for such a revolutionary change in these long established names.

introduction from Europe, the first known American specimens having been noticed in eastern Pennsylvania in the spring of 1887; it has now extended over nearly all of North America. An allied species is indigenous to North America, living among the moose of the northern woods. The tsetse flies* are perhaps the most famous of the group. The diseases produced by the microparasites (trypanosomes) transferred into their victims by their elongated piercing proboscis are so dire in their results that the regions certain species inhabit are rendered almost uninhabitable by the domestic animals. The diseases also afflict certain wild animals, though with less fatal results. The microparasites are, themselves, apparently not regenerated in the flies, as is the case with the mosquitoes, but are transferred by them shortly after biting diseased animals to healthy ones. The fatal 'sleeping sickness' (trypanosomiasis) in man is occasioned in the same way by the bites of *Glossina palpalis*. The larvæ of *Glossina* are born when well developed and ready, or about to be ready, to become pupæ, resembling those of the Hippoboscidæ in this respect.

The limits of the Muscidæ, both from the Sarcophagidæ and the Anthomyidæ, are quite elusive and uncertain; indeed they seem almost impossible of definition save by the aid of artificial and trivial characters. Girschner, and some other authors following him, would unite the Calliphorinæ, that is those with hypopleural bristles, with the Sarcophagidæ or Tachinidæ. The logical sequence would be to unite the Muscinæ with the Anthomyidæ, abandoning the family. His views, however, have not been generally adopted. One genus with bare arista has been generally united with the family, so that the ultimate distinction from the Tachinidæ would

* An amateur dipterist has recently proposed in all seriousness to separate the tsetse flies into an independent family, the Glossinidæ!

seem to be the lack of hirsuteness of the abdomen. On the other hand, there seems to be no real distinction from the Anthomyidæ, unless the almost evanescent curvature of the fourth vein be considered as such.

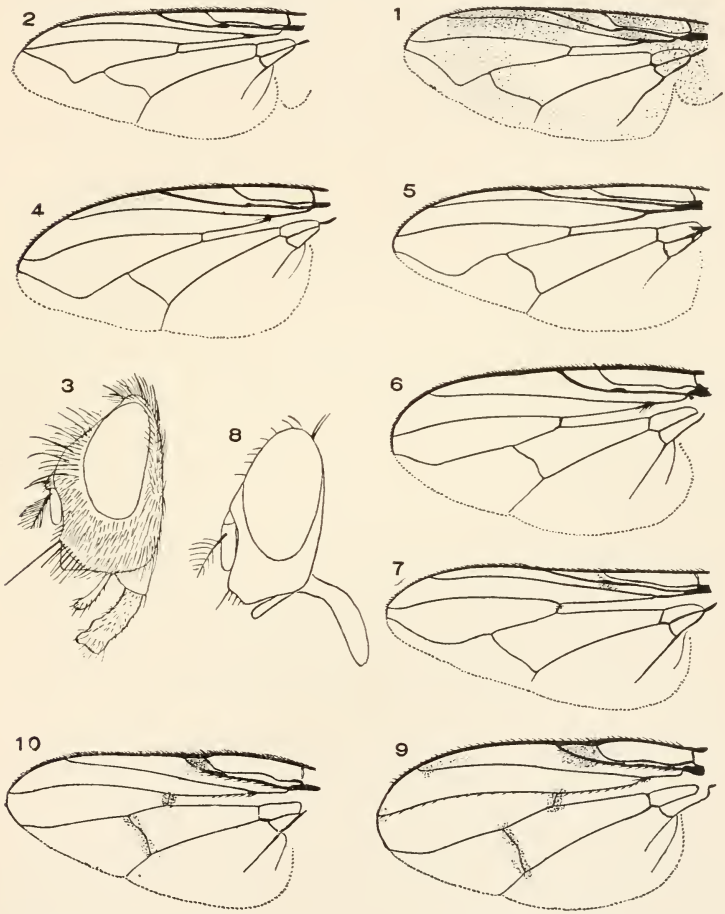


Fig. 139. Muscidæ. 1, *Chrysomyia;* 2, 3, *Pollenia;* 4, *Mesembrinella;* 5, *Graphomyia;* 6, *Myiospila;* 7, 8, *Morellia;* 9, *Muscina;* 10, *Clinopera.*

The larvæ of *Muscina* have been found in decaying vegetables, dung, fungi and the larvæ of various lepidoptera, a remarkable diversity of habits. The larvæ of *Graphomyia* and *Mesembrina* have been found in horse and cow dung.

TABLE OF GENERA.

1. Proboscis long, slender, directed forward; arista pectinate, or sometimes with a few hairs below also. 2
   Proboscis not elongate, the labella fleshy and not adapted for piercing. 3

2. Palpi nearly as long as the proboscis (*Lyperosia;* fig. 146). **Hæmatobia.**
   Palpi much shorter than the proboscis. . . . **Stomoxys.**

3. Arista bare; distal section of the fourth vein broadly curved at its end. . . . . **Synthesiomyia.**
   Arista pectinate. . . . . **Hemichlora.**
   Arista plumose. 4

4. Hypopleuræ with a vertical row of bristles. 5
   Hypopleuræ not with a row or tuft of bristles. . . . 14

5. Eyes pubescent. . . . . **Tyreomma.**
   Eyes bare. 6

6. Vibrissal angle at a considerable distance above the oral margin; angle of fourth vein rounded or rectangular. . . . 7
   Vibrissal angle near oral margin. 8

7. Thorax and abdomen with depressed hairs or tomentum among the bristles, especially noticeable in the intraalar region; dark-colored, slow moving 'cluster flies' (2, 3) . **Pollenia.**
   Thorax and abdomen not with such hairs; mesonotum distinctly striped; bright metallic flies (1). . . **Chrysomyia.**

8. Bend of fourth vein augular, or with the angle slightly rounded. 9
   Distal section of fourth vein with a broad curve; cheeks bare; rather large flies, reddish or yellowish, with the distal portion of the abdomen metallic (4). . . . **Mesembrinella.**

9. Dorsocentral bristles present. 10
   Dorsocentral bristles absent. . . . **Chloroprocta.**

10. Arista usually plumose for not more than two-thirds its length; hypopygium prominent. . . . . **Cynomyia.**
    Arista plumose to tip; hypopygium not prominent. . . 11

11. Mesonotum not flattened behind the transverse suture. . 12
    Mesonotum flattened behind the transverse suture. . . 13

12. Posterior dorsocentral and acrostical bristles well-developed and constant; cheeks hairy; third longitudinal vein spinulose at base only. . . . . **Calliphora.**
Posterior dorsocentral and acrostical bristles constant and well-developed; cheeks bare; first section of the third vein for a part or all its length spinulose. . . . . **Lucilia.**

13. Posterior dorsocentral and acrostical bristles inconstant and unequally developed; cheeks hairy; first section of third vein in large part spinulose. . . . . **Phormia.**
Posterior dorsocentral well, the acrostical bristles unequally developed, cheeks hairy; first section of third vein in large part spinulose. . . . . **Protocalliphora.**

14, Middle tibiæ with a prominent bristle on its inner, flexor surface beyond the middle. 15
Middle tibiæ without such bristle. 17

15. Termination of first longitudinal vein nearly opposite the middle of the penultimate section of the fourth vein; distal section of the latter forming a broad curve. . . **Mesembrina.**
Termination of first vein nearly opposite the anterior cross-vein. 16

16. Sternopleuræ with one bristle in front and two behind; angle of fourth vein rounded. . . . . **Pseudopyrellia.**
Sternopleuraæ with one bristle in front and three behind; last section of fourth vein forming a broad, gentle curve. **Pyrellia.**

17. The last section of the fourth vein has a rounded angle; sternopleuræ with one bristle in front and two behind; never metallic species. . . . . **Musca.**
Last section of fourth vein broadly curved near its middle, or with an anterior flection at its tip. 18

18. Eyes pubescent. 19
Eyes bare. 20

19. Antennæ separated at their base by a distinct carina; sternopleuræ with two bristles behind, none in front; body gray or partly rufous with a well-defined black pattern (**5**). **Graphomyia.**
Antennæ not separated at base by carina; sternopleuræ with two bristles in front and two behind; body not metallic colored. **Myiospila.**

20. Last section of fourth vein with a broad curvature near its middle. the cell opening rather narrowly; grayish or metallic spotted species (**7, 8**). . . . . **Morellia.**
Last section of fourth vein curved forward, often slightly, beyond its middle or at the tip, the cell broadly open. . . . 21

21. First longitudinal vein ends beyond the middle of the wing; one or more well-developed pairs of anterior acrostical bristles (**9**). **Muscina.**
The first vein ends before the middle of the wing; no anterior acrostical bristles (**10**). . . . . **Clinopera.**

Somomyia, *Cyrtoneurina* and *Hyadesimyia* are not included in the table, because of insufficient data.

LV. Family ŒSTRIDÆ.

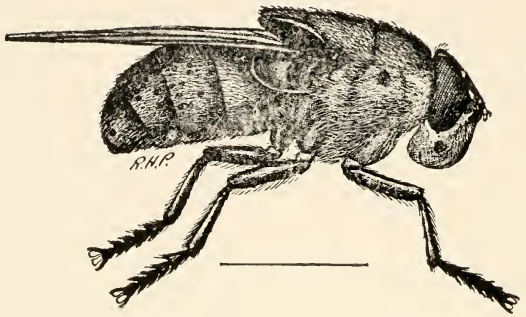


Fig. 140. *Cuterebra buccata*, enlarged; after Washburn.

Flies of moderate to large size, thick-set, usually more or less pilose. Head large, the lower part more or less swollen. Antennæ short, three-jointed, decumbent, and more or less sunken in the facial groove or grooves; arista bare or plumose. Mouth opening small, the mouth-parts sometimes rudimentary, never large. Front broad in both sexes, in the male broader in front. Eyes comparatively small, bare. Ocelli present. Thorax robust, with a distinct transverse suture. Abdomen short, conical or but little elongated; genitalia of the male hidden, the ovipositor sometimes elongated. Squamæ usually large; sometimes small. Venation of the wings muscid-like, in most cases the first posterior cell narrowed or closed; anal cell small, sometimes indistinct; discal cell sometimes absent.

This family, though of small size comparatively, is of the greatest interest by reason of the habits of the larvæ, all of which that are known being parasitic upon mammals. The adult flies often have vestigial mouth-parts,

and devote the whole of their brief existence to the labors of procreation. Only about seventy-five species are known, and they are generally called bot-flies, though the name is frequently applied especially to the bot-fly of the horse. Parasitism occurs in three principal ways: in the stomach and digestive tubes, in tumors formed by the larvæ under the skin, and in the pharyngeal and nasal cavities. With but few exceptions each species is confined to a single species of mammal, and each genus or each group of allied species is parasitic in the same way upon allied animals. Seven species of *Gastrophilus* are found in the stomach and intestines of the horse and ass. Thirteen species of *Hypoderma* are known to live under the skin of the horse, the ox, the buffalo, the sheep, the goat, four species of antelope, and the musk-deer. Two species of *Œstromyia* likewise infest the skin of *Lagomys* and *Hypodæus*. *Œdamagena tarandi* is parasitic in great numbers in the skin of the reindeer in both Siberia and boreal America. Four or five species of *Œstrus* live in the nasal sinuses of sheep, antelope, and horse (*Rhinœstrus*). One species of *Cephalomyia* lives in the nasal cavities and throat of the camel and buffalo. Six or seven species of *Cephenomyia* have been found parasitic in the pharyngeal cavities of various Cervids, while various species of *Cuterebra*, *Bogeria* and *Rogenhofera* have been bred from the skin or scrotum of rodents and opossums. Two species of *Dermatobia* have been obtained from the skin of dogs, cattle, cats, deer, and probably apes and man. The eggs or young larvæ are, it is believed, in all cases taken into the mouth by the animals which they infest, going thence to the sinuses, pharynx or stomach; or, through the tissues of the body, to the skin. Perhaps those living within the scrotum may reach their abiding place by a more direct route.

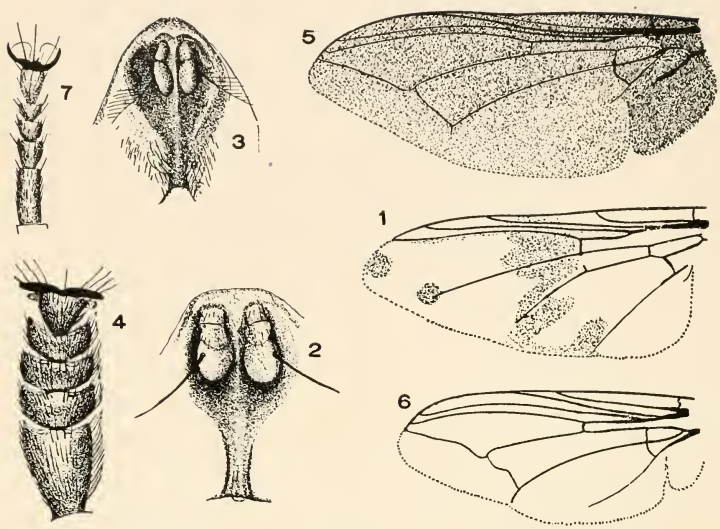


Fig 141. Œstridæ. 1, *Gastrophilus*, wing; 2, *Gastrophilus*, antennæ; 3, *Cuterebra*, antennæ; 4, *Cuterebra*, front tarsus; 5, *Cuterebra*, wing; 6, *Dermatobia*, wing; 7, *Dermatobia*, front tarsus.

TABLES OF GENERA.

IMAGINES.

1. Mouth-parts very small, vestigial; arista bare. 2
   Proboscis geniculate, inserted in a deep slit; female without extricate ovipositor; first posterior cell narrowed or closed; arista bare or plumose; facial grooves approximated below, enclosing a narrow median groove or depressed surface; squamæ large. 6

2. The fourth longitudinal vein runs straight toward the border of the wing, i. e. the apical cross-vein is obsolete, and the first posterior cell is not narrowed; squamæ small; female ovipositor elongate; larvæ in stomach and intestinal canal (1, 2).
   Gastrophilus.
   The fourth vein turns forward to form the apical cross-vein, closing or narrowing the first posterior cell. 3

3. Facial grooves approximated below, leaving a narrow median groove or depression. 4

Facial grooves remote, enclosing between them a broad, gently arcuate, shield-shaped surface; squamæ large; female with elongate ovipositor; larvæ hypodermatic. 5

4. First posterior cell closed and petiolate; body nearly bare. **Œstrus**
First posterior cell narrowly open; body pilose. **Cephenomyia.**

5. Palpi wanting. . . . . **Hypoderma.**
Palpi small, globular. . . . . **Œdamagena.**

6. Arista bare, short and stout; wings without stump at angle of fourth vein. . . . . **Bogeria.**
Arista pectinate above. 7

7. Tarsi broad and flattened, hirsute (**3, 4, 5**); alulæ large. **Cuterebra.**
Tarsi slender, not hirsute; third joint of antennæ more elongate; front prominent anteriorly; alulæ of moderate size (**6, 7**). **Dermatobia.**

LARVÆ.

1. Last abdominal segment free, broadly attached. 2
Last abdominal segment (twelfth) retractile within the preceding, small and distinctly constricted. 7

2. Larvæ with two pairs of chitinized jaws; that is with two outer mouth-hooklets, and two inner, straight, triangular points (Horses). . . . . **Gastrophilus.**
Larvæ with two or no mouth-hooklets. 3

3. Larvæ on the median segments with dorsal, spindle-shaped tubercles; one pair of mouth-hooklets present. 4
Larvæ without such tubercles; one pair or no mouth-hooklets present. 5

4. Antennæ broadly separated; body oval, strongly convex above, flat below (Sheep). . . . . **Oestrus.**
Antennæ approximated or contiguous; body elongated, somewhat broader in front than behind (Deer). . **Cephenomyia.**

5. No mouth-hooklets. 6
Two small mouth-hooklets present (Rodents). **Oestromyia.**

6. Bristly covering alike above and below (Reindeer). **Œdamagena.**
Bristles stronger below than above (Ox, etc.) **Hypoderma.**

7. Larvæ oval (Rodents, Marsupials). . . . **Cuterebra.**
Larvæ club-shaped, more slender posteriorly (Artiodactyls, Carnivora. Primates). . . . . **Dermatobia**

LVI. Family SARCOPHAGIDÆ.

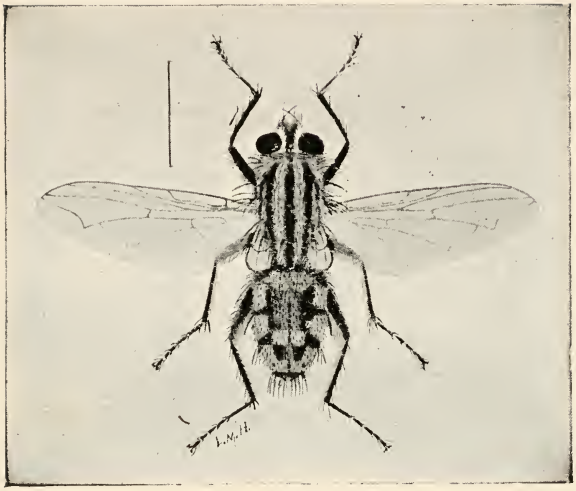


Fig. 142. *Sarcophaga saracenia*, enlarged. After Washburn.

Usually thick-set, moderately large to rather small flies. Front in both sexes broad, though usually somewhat narrower in the male. Arista of the antennæ plumose to the middle or a little beyond, the distal portion bare; this last character alone is the ultimate distinctive one of the group. Abdomen composed of four visible segments, with the macrochætæ usually confined to the distal portion, though sometimes occurring on the margin of the second and following segments and very rarely on the disk; male hypogygium often prominent. First posterior cell of the wings always much narrowed or closed.

This family of flesh-flies, as they are often called, though comprising but comparatively few genera, has a great number of species and individuals. For the most part the species are tolerably uniform in coloration, and at first sight seem scarcely distinguishable, having a gray striped thorax and marmorate abdomen. The more metallic colored species of *Cynomyia* and *Onesia* are exceptions. The flies are found everywhere, about decaying vegetation, especially fruit, excrement, decomposing carcasses, etc.

The larvæ are polyphagous in habit, feeding upon decaying animal or vegetable matter, or living parasitically in the flesh of different animals, in the nasal cavities of man and other animals, in ulcers, etc. The larvæ of *Cynomyia* live in great numbers in the decomposing carcasses of vertebrate animals. The larvæ of *Sarcophaga*, which are often extruded by the parent fly alive, have been found under the skin of turtles, in the stomachs of frogs; and most of the cases of myiasis that have been reported, other than those due to the larvæ of *Chrysomyia* and *Calliphora*, have been caused by the maggots of the species of this genus and those of *Sarcophila*. The larvæ of several species have been found in snails, in beetles, grasshoppers, the pupæ of moths, etc.

The Sarcophaga larvæ are rounded, thinner anteriorly and amphipneustic. The antennæ are short, thick, cylindrical, divergent, wart-like tubercles, each with two ocellus-like chitinous rings at the tip. The mouth-hooklets are distinct, strongly curved, and separated from each other. The abdominal segments are distinctly differentiated by transverse swellings, and are each provided with a girdle of spines. The hind stigma-plate is situated in a deep cavity, which is formed by the last segment alone. The anal swelling is two-pointed. The puparium is oval.

Fig. 143. *Peckia præceps*, enlarged.

TABLE OF GENERA.

1. First posterior cell closed or much narrowed in the margin. 2
   First posterior cell open. 5
2. Second and third abdominal segments with discal and marginal macrochætæ. . . . . **Paramintho.**
   Second and third segments without discal macrochætæ. . 3
3. First vein bristly. . . . . **Johnsonia.**
   First vein bare. 4
4. Arista bare or pubescent. . . . . **Hesperomyia.**
   Arista distinctly plumose. . . . . **Sarcophilodes.**
5. Abdomen black or metallic, unicolorous and but slightly pruinose. 6
   Abdomen gray or partly ochraceous, with black reflecting spots. 8
6. Hypopygium very prominent; legs more or less hairy. . 7
   Hypopygium concealed; legs not hairy; curvature of fourth vein with an obtuse angle and without stump. . . **Onesia.**
7. Abdomen usually black; tibiæ densely hairy. . . **Peckia.**
   Abdomen metallic; tibiæ with short hairs (see Muscidæ). **Cynomyia.**

8. All the tibiæ with a comb-like row of long stout bristles externally. **Theria.**
   Without such bristles, or with irregularly placed ones. . 9

9. Cheeks with long bristly hairs below. 10
   Cheeks with short pile. . . . . **Erythrandra.**

10. Last section of fourth vein more oblique than the posterior cross-vein. 11
    Both veins in nearly the same straight line; two orbital bristles in the female; none in the male. . . . **Sarcophaga.**

11. Two orbital bristles in each sex. . . . **Sarcophagula.**
    Two orbital bristles in the female, male? . . **Helicobia.**

Sarcodexia and *Sarothromyia* are not included in the table for lack of sufficient data.

LVII. Family DEXIIDÆ.

Rather small to large, chætophorous flies, thinly or not at all pilose, usually more elongate than the Tachinidæ. Eyes of the male contiguous, or more approximated than those of the female; pubescent or bare. Front with a row of bristles on each side descending to, but not below, the base of the antennæ, save rarely. First joint of antennæ short; second usually shorter than the third; third joint more or less elongate, sometimes short, decumbent. Arista bare, pubescent or pilose, with two or three visible joints. Face always with a well-marked median depression, with a more or less distinct median ridge or carina. Proboscis sometimes elongate, but usually short and with broad labella; palpi never with more than one joint, which is sometimes vestigial. Ocelli present. Abdomen composed of four or five visible segments, with marginal, lateral, and usually discal bristles. Legs sometimes rather stout; usually elongate and slender; always bristly. All veins of wings simple; basal cells large; three posterior cells present, the first of which is always narrowed or closed; auxiliary vein distinct in its whole length. Squamæ large.

In habits and life histories, the Dexiidæ closely resemble the Tachinidæ, and the distinction between the two families is very difficult to make, if it is not actually evanescent. The plumose or distinctly pubescent arista, the presence of bristles on the dorsum of the abdomen, together with the usually more slender legs, are the essential diagnostic characters of the family. For further study the reader is referred to the works of Brauer, Bergenstamm, Coquillett, Townsend and Wulp.

Fig. 144. *Dexia*, species. Enlarged.

Fig. 145. *Scotiptera melaleuca*. Enlarged.

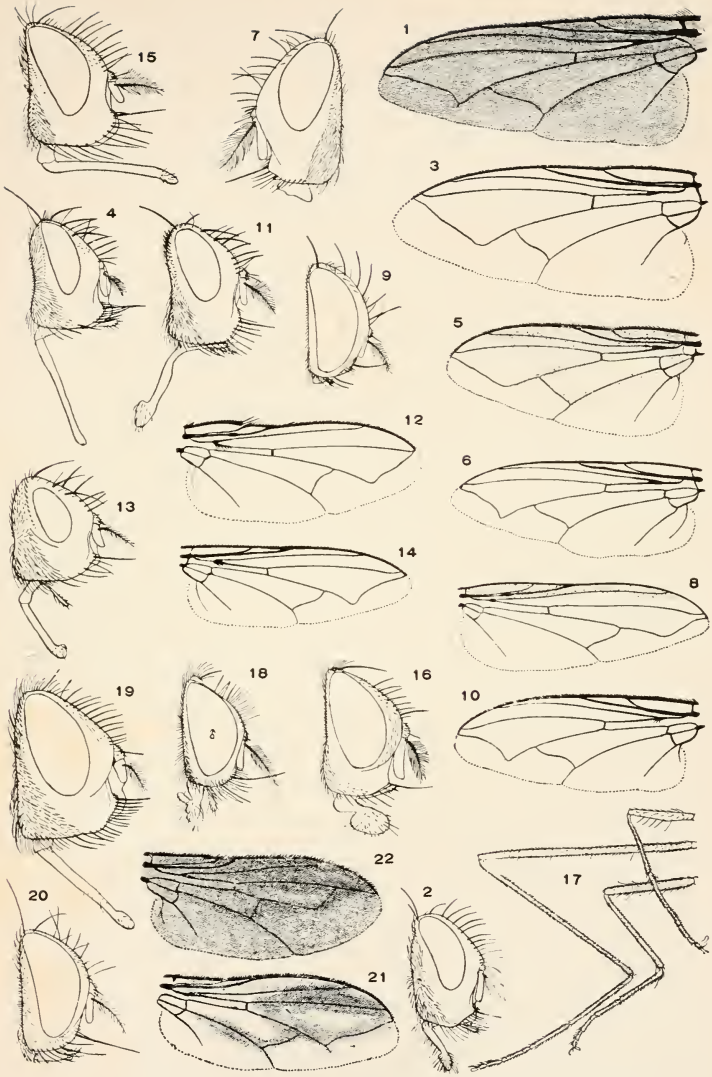


Fig. 146. Dexiidæ. 1, 2, *Scotiptera melaleuca*, wing, head; 3, 4, *Hystricoddexia raderi*, wing, head; 5, *Chætona*, sp. wing; 6, 7, *Leptopoda gracilis*, wing, head; 8, 9, *Calodexia*, wing, head; 10, 11, *Ptilodexia tibialis*, wing, head; 12, 13, *Myiocera*, sp. wing, head; 14, 15, *Rhynchodexia*, sp. wing, head; 16, 17, *Cholomyia nigriceps*, head, legs; 18, *Morinia*, head; 19, *Rhynchodexia*, head; 20, *Thelaira longicornis*, head; 21, *Enantha*, sp. wing; 22, *Melanophora roralis*, wing.

TABLE OF GENERA.

BY PROF. C. F. ADAMS.

1. Proboscis elongate; slender, not retractile, usually as long or longer than the dorso-ventral diameter of the head. . . . 2
   Proboscis shorter than the head, thick and retractile. . . 15

2. Proboscis slender and rigid, nearly or quite as long as the head and thorax together; labella small. 3
   Proboscis as long as or but little longer than the head. . 8

3. Scutellum and abdomen armed with spines. . **Hystrisiphona.**
   Scutellum and abdomen with the usual macrochætæ. . . 4

4. Sides of face bare. 5
   Sides of face clothed with short bristles. . **Prorhynchops.**

5. Palpi very short, thickened at tip; macrochætæ only marginal. **Prosena.**
   Palpi moderately long, not at all or but little thickened at tip; macrochætæ usually discal and marginal. 6

6. Claws of male extraordinarily long. . . **Mochlosoma.**
   Claws of both sexes short. 7

7. Facial carina broad, inflated, depressed. . . **Myiomima.**
   Facial carina narrow, not inflated, compressed. **Prosenoides.**

8. Abdomen densely covered with macrochætæ. . . . 9
   Abdomen with regularly arranged macrochætæ. . . . 10

9. Vibrissæ inserted some distance above oral margin (**3, 4**). **Hystricodexia.**
   Vibrissæ inserted on oral margin. . . . **Bathydexia.**

10. Eyes descending not more than two-thirds the distance to lateral oral margin. 11
    Eyes descending at least three-fourths the distance to lateral margin. 14

11. Fourth vein with a stump at its bend (**1, 2**). . **Scotiptera.**
    Fourth vein without stump at its bend. 12

12. Macrochætæ of abdomen discal and marginal. . . . 13
    Macrochætæ only marginal (**12, 13**). . . **Myiocera.**

13. Face quite concave in profile; vibrissæ at oral margin. **Myioscotiptera.**
    Face nearly perpendicular; vibrissæ some distance above oral margin (**14, 15, 19.**) . . . . . **Rhynchodexia.**

14. Facial ridges parallel; antennæ inserted on line drawn through middle of eyes. . . . . **Tromodexia.**
Facial ridges divergent below; antennæ inserted somewhat below middle of eyes (Tachinidæ, **112**). . . **Stomatodexia.**

15. Eyes descending less than or hardly more than two-thirds the distance to lateral oral margin. 16
Eyes descending nearly to lateral oral margin. . . . 40

16. Apical cell petiolate or closed in the margin. . . . 17
Apical cell open. 21

17. Posterior cross-vein nearer to bend of fourth vein than to the anterior cross-vein, or in the middle. 18
Posterior cross-vein nearer to anterior cross-vein than to bend. 20

18. Fourth vein with stump at bend. . . . . **Megerlea.**
Fourth vein without stump. 19

19. Third antennal joint scarcely longer than second; cheeks without long, bristly hairs below. . . . . **Megaparia.**
Third joint more than twice as long as second; cheeks with long bristly hairs below. . . . . **Melanodexia.**

20. Sides of face narrow, bare (**22**). . . . **Melanophora.**
Sides of face broad, bristly. . . . . **Microchætina.**

21. Face distinctly carinate. 22
Face not carinate or but slightly so. 28

22. Antennæ nearly as long as the face. . . . **Camarona.**
Antennæ much shorter than the face. 23

23. Abdomen wide and stout; short; oval, the first segment somewhat shortened. 25
Abdomen conical or elongate oval. 24

24. Sides of face bristly above. . . . . **Gymnodexia.**
Sides of face wholly bare (fig. 144). . . . . **Dexia.**

25. Sides of face bare. 26
Sides of face hairy. . . . . **Trixodes.**

26. Abdomen with discal and marginal macrochætæ. . . 27
Abdomen without discal macrochætæ. . . **Ateloglossa.**

27. Arista bare or pubescent. . . . . **Megaprosopus.**
Arista long plumose. . . . . **Phorostoma.**

28. Antennæ inserted at or above the middle of the eyes. . 29
Antennæ inserted below middle of eyes. 32

29. Arista short-haired; posterior cross-vein half way between bend of fourth vein and the anterior cross-vein. 30
Arista distinctly plumose; posterior cross-vein near bend of fourth vein. 31

30. Eyes bare. . . . . **Acronacantha.**
Eyes hairy. . . . . **Morphomyia.**

31. Antennæ not reaching middle of face. . . **Phasiops.**
Antennæ reaching at least two-thirds the distance to oral margin. **Metadexia.**

32. Eyes small, less in diameter than the width of cheeks. **Macrometopa.**
Eyes of greater diameter than width of cheeks. . . . 33

33. Costa of wings bristly, or at least with a costal spine. . . 34
Costa without bristles or spine. 36

34. Abdomen elongate, nearly cylindrical, twice as long as the thorax; segments of equal length. . . . . **Stenodexia.**
Abdomen short, stout, the first segment somewhat shortened. 35

35. Sides of face hairy; claws of male elongate (10). **Ptilodexia.**
Sides of face bare. . . . . **Sardiocera.**

36. Abdomen conical or elongate oval. 37
Abdomen cylindrical or elongate-conical, much longer than thorax. 38

37. Middle legs of male disproportionately long (16, 17). **Cholomyia.**
Middle legs but little if any longer than the others. **Melaleuca.**

38 Apical cell widely open; wings unicolorous (21). . **Euantha.**
Apical cell narrowly open; wings nearly hyaline. . . 39

39. Eyes bare (6, 7). . . . . **Leptoda.**
Eyes hairy. . . . . **Uramyia.**

40. Abdomen cylindrical, long and attenuated at base. **Cordyligaster**
Abdomen oval or conical, not petiolate. 41

41. Frontal bristles descending below base of antennæ (5). **Chætona.**
Frontal bristles not descending below base of antennæ. . 42

42. Third vein with a row of bristles. 43
Third vein without bristles, save at base. 45

43. Third antennal joint four times the length of the second. **Thelairodes.**
Third joint about twice the length of the second. . . 44

44. With discal and marginal macrochætæ (20). . . **Thelaira.**
Without discal macrochætæ. . . . . **Polygaster.**

45. Abdomen yellow, with or without black markings. . . 46
Abdomen black, sometimes partly whitish or cinerous. . 47

46. Apical cell broadly open. . . . . **Xanthodexia.**
Apical cell narrowly open (8, 9). . . . **Calodexia.**

47. Curvature of fourth vein arcuate. . . **Rhombothyria.**
Curvature of fourth vein angular. 48

48. Arista short-hairy. . . . . **Pseudomorinia.**
Arista distinctly plumose. 49

49. Eyes bare (18). . . . . **Morinia.**
Eyes hairy. . . . . **Comyops.**

The following genera are not included in the foregoing table: *Echinodexia*, *Eudexia*, *Paraprosena*, *Dexiosoma*, *Pseudodexia*, *Cyrtosoma*, *Theresia*, *Homodexia*.

NOTES ON THE FIGURES.

BY PROF. C. H. T. TOWNSEND.

Figs. 3, 4. I propose for this species the new genus *Euchætogyne*. I identify the species with specimens from the Sierra Madre of western Chihuahua.

5. In the genotype the apical cell probably ends at the wing tip.

8, 9. The figures agree with a specimen of *Calodexia* in U. S. Nat. Mus. but the posterior cross-vein is nearer the bend of the fourth vein.

10, 11. Both figures agree with specimens of *Clinoneura*, female, and the wing with *Ptilodexia* also, but not the head.

12, 13. The figure of the head is typical of *Myiocera*, except that there is a pair of strong reclinate vertical bristles in female.

14, 15. *Rhamphinina*, sp. male. The figures agree with specimens which I refer to *Rhamphinina*, differentiated from *Rhynchodexia* by the absence of facial carina.

19. *Rhynchodexia*, sp. male. Appears to be this genus, distinguished from *Euchætogyne* by the absence of strong reclinate vertical bristles.

20. *Thelaira*, sp. male: Quite typical, but the species is probably not *T. longicornis*, which Brauer refers to *Pseudodexia*.

21. *Euantha liturata* male. A costal spine is present. The wing of the female is more deeply clouded.

22. *Melanophora roralis*. The petiole of apical cell originates usually a little before point opposite to end of second vein.

LVIII. Family TACHINIDÆ.

Fig. 147. *Exorista affinis*, enlarged. After Washburn.

Rather small to rather large, bristly flies, thinly or not at all pilose, usually thick-set. Eyes pubescent or bare; those of the male more approximated than those of the female, or contiguous. Front with a row of bristles on each side, descending to or below the base of the antennæ; with or without orbital bristles. First antennal joint short; second joint usually shorter than the third; third joint usually more or less elongated, sometimes dilated or fissured; decumbent; arista bare, three-jointed, the first joint always short, often atrophied and imperceptible; second joint sometimes elongate (13) and geniculate. Face always with a well-marked median depression, which sometimes has a carina in its middle. Proboscis sometimes elongate and slender, but usually short and with broad labella; palpi never with more than one joint, which is sometimes rudimentary. Ocelli present. Abdomen composed of four or five visible segments; with mar-

ginal and lateral, and usually with discal bristles; sometimes nearly covered with strong, erect spines. Legs usually rather stout, seldom moderately elongate; always with bristles. All the veins of the wings simple; basal cells large; three posterior cells present, the first of which is always narrowed or closed (save in those rare cases in which the distal section of fourth vein is obliterated); auxiliary vein distinct in its whole course. Squamæ large.

No other group of flies has presented so many difficulties to the student of systematic dipterology as the present one. In its entirety, with few exceptions, it is easily differentiated. Flies that have the arista bare (or at the most, pubescent), the squamæ well developed, and the first posterior cell narrowed or closed, may be unhesitatingly referred to this family. But the family is not always easily distinguished from the Dexiidæ. The presence, however, of aristal plumosity, with the other characters of the more typical tachinids, that is those of which the dorsum of the abdomen is distinctly bristly, will remove doubt of the correct location of any species possessing such characters, even when the legs do not have the elongation characteristic of the more typical dexiids. Unfortunately the differentiation of the genera and species is vastly more difficult, and will require much patient study even yet before a satisfactory stability is reached. The student should not be discouraged if he is not always sure of his results,—the most of us are often in doubt about Tachinidæ. About one hundred and eighty-five genera have already been accredited to North America. Some of these will doubtless be reduced to synonyms, but not many, since the characters used for generic limitation are often exceedingly slight, such as in many other families are considered of specific value only. So inconspicuous are the distinguishing characters in many species that only the experienced eye will detect them.

For further study of the family the reader is referred to the various works of Brauer and Bergenstam, v. d. Wulp, Townsend and Coquillett.

The habits of the mature fly are similar for nearly all the members of the group. They will be found on vegetation, on leaves or flowers, in such places as are frequented by the hosts which they parasitize. Not a few will be caught with the beating net.

The larvæ of the more typical Tachinidæ are thickened, cylindrical and flattened below, the segments indistinctly differentiated, with transverse and lateral swellings, bare or provided with fine, short shines. They are amphipneustic, the anterior spiracles small and point-like or multipartite, the posterior stigmatic plates large, strongly chitinized, and each with three, internally convergent grooves. The antennæ are wart-like, with two, ocellus-like, chitinous rings, one lying below the other. There are but two mouth-hooklets, porrect and but little curved. The puparia are oval, with the segments slightly differentiated; the skin is finely wrinkled, and both ends are rounded.

In *Ocyptera* and *Gymnosoma*, and probably in allied forms, the larvæ have a chitinous, anal stigmatic tube; and the puparia have six or two, similar processes. The larvæ of *Hyalomyia* are translucent, smooth and metapneustic, the mouth-hooklets very large; there are two, short, divergent, anal tubes.

The larvæ of this group are all parasitic in habit so far as known, and the parasitism is probably confined to the early stages of other insects; and the individual fly is not very particular in the choice of larvæ which she parasitizes. Their usefulness in keeping injurious insects in check is immeasurable.

By far the largest number of species are parasitic upon Lepidoptera, of which not less than four hundred have

been recorded. About seventy species are known to be parasitic upon Hymenoptera, less than forty upon Coleoptera, a score upon Orthoptera, five upon Hemiptera, and as many upon other Diptera.

The figures of the first plate (1–17) were kindly made by Professor Aldrich. The remainder (18–114), by myself, have been drawn as carefully as possible. Not being a specialist in this family, it was not always possible to be quite certain of the characters. Professor Townsend has, however, with great kindness examined the figures carefully, and has criticised them in an appendix to this family (p. 378), which should be consulted by the student.

TABLE OF GENERA.

BY PROF. C. F. ADAMS.

1. Apical cell (first posterior) ending at or close to the extreme wing tip. 2
   Apical cell ending some distance before the extreme tip. . 76
2. Abdomen without macrochætæ. 3
   Abdomen with macrochætæ. 11
3. Sides of face bare. 5
   Sides of face with bristly hairs. 4
4. Third and fourth veins nearly equally convergent. **Gymnophania**
   Fourth vein more convergent than the third (**18, 19**). **Acaulona**
5. Hind tibiæ outwardly ciliated with a row of erect bristles. . 6
   Hind tibiæ not ciliated. 7
6. Apical cell open. . . . . **Homogenia.**
   Apical cell closed. . . . . **Trichopoda.**
7. Abdomen subspherical, the upper side very convex. . . 8
   Abdomen without such convexity. 10
8. Antennæ not reaching the lower third of the face. . . 9
   Antennæ reaching at least the lowest fifth of the face. **Gymnosoma.**
9. Abdomen with five visible segments (**18, 19**). **Acaulona.**
   Abdomen with only four visible segments, or the fifth very short (**10**). . . . . **Cistogaster.**
10. Sides of the front hairy except a narrow space along each eye (**20**) **Alophora.**
    Sides of front bare except two or three rows of hairs along each side of the frontal vitta (**21**). . . . **Phorantha.**
11. Sides of face with hairs or macrochætæ on lower half. . 12
    Sides of face, or at least lower half, bare. 25

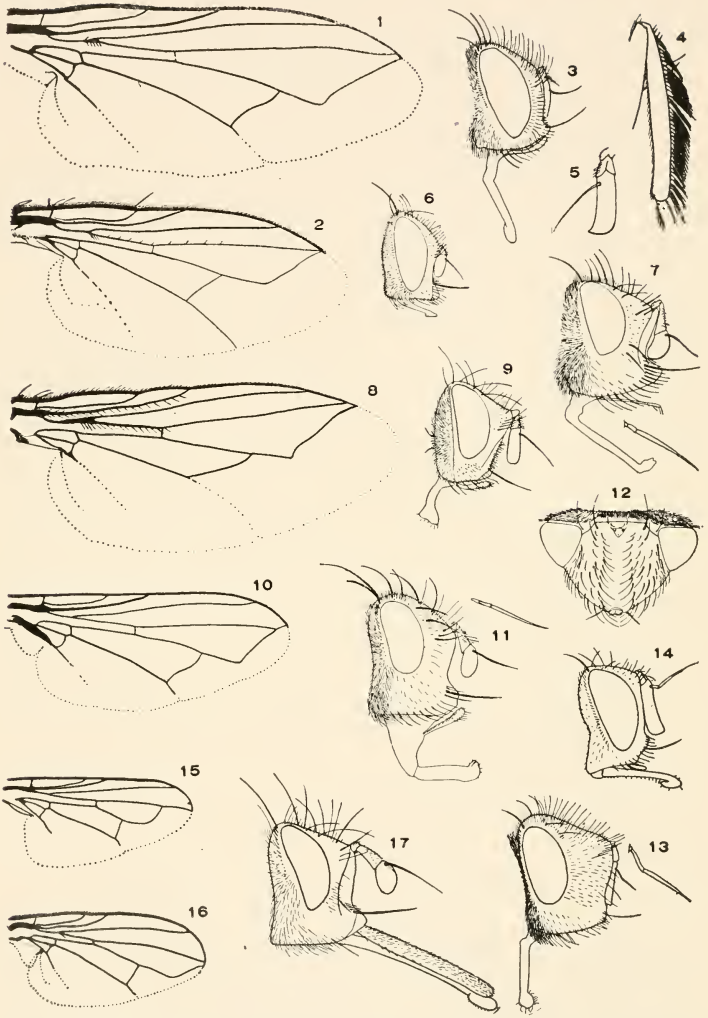


Fig. 148. Tachinidæ. 1, *Masicera festinans*, wing; 2, *Aphria occidentalis*, wing; 3, *Spallanzania hebes*, head; 4, *Blepharipeza adusta*, tibiæ; 5, *Acemyia dentata*, antennæ; 6, *Atacta*, sp. head; 7, *Peleteria neglecta*, head; 8, *Plagia americana*, wing; 9, *Tachina robusta*, head; 10, *Cistogaster maculata*, wing; 11, *Archytas*, sp. head; 12, 13. *Gonia capitata*, head, top and side; 14, *Thryptocera* (*Clausicella ?*), sp. head; 15, *Phorantha*, sp. wing; 16, *Clausicelta setigera*, wing; 17, *Dejeania rexatrix*, head. Figs. 1–17 by J. M. Aldrich.

12. Abdomen subopaque, partly or wholly covered with pollen. 15
Abdomen largely or wholly shining and without pollen. 13

13. Palpi well developed. 14
Palpi vestigial, filiform, terminating in a long bristle.
Atrophopalpus.

14. Abdomen wholly shining (**35**). . . . . **Myiophasia.**
Base of last three abdominal segments gray pruinose.
Paradmontia.

15. Eyes bare, or with indistinct, short hairs. 18
Eyes distinctly hairy. 16

16. Vibrissæ on a level with oral margin. 17
Vibrissæ distinctly above oral margin. . . . **Meigenia.**

17. Posterior cross-vein about midway between anterior cross-vein and bend of fourth vein. . . . . **Eulasiona.**
Posterior cross-vein close to bend of fourth vein. **Lasiona.**

18. From one to three pairs of frontal bristles below base of antennæ; antennæ at least two-thirds as long as face. 10
No frontal bristles below base of antennæ. 19

19. Cheeks two-thirds as broad as the eye-height (**20, 21.**) **Phyto.**
Cheeks less than two-thirds of eye-height (**32, 33**). **Rhinophora**

20. First posterior cell open, or, if closed, short petiolate. . 22
First posterior cell closed and long petiolate, the petiole two-thirds as long as the posterior cross-vein. 21

21. First vein bristly. . . . . **Paradmontia.**
First vein not bristly. . . . . **Mauromyia.**

22. Third vein not bristly on more than one-fourth the distance to anterior cross-vein; sides of face without macrochætæ. . 23
Third vein bristly on at least three-fourths the distance to anterior cross-vein; sides of face with macrochætæ (**23, 24**).
Ceratomyiella.

23. Face in profile strongly convex; orbital bristles usually present in both sexes; front tarsi of male usually dilated. **Admontia.**
Face strongly receding; female with two orbital bristles.
Sarcoclista.
Face in profile concave; orbital bristles wanting in male. . 24

24. First vein beyond tip of auxiliary vein distinctly bristly.
Meigeniella.
First vein not bristly beyond tip of auxiliary (**24**).
Cryptomeigenia.

25. Proboscis shorter or only slightly longer than height of head. 26
Proboscis at least one-third longer than height or head. . 71

26. Frontal vitta opaque, ... 27
Frontal vitta shining (**37, 38**). . . . . **Hemyda.**

27. Vibrissæ on a level with oral margin. 28
Vibrissæ distinctly above oral margin. 58
Vibrissæ not distinguishable from the hairs on the facial ridges.
Trixa.

28. Penultimate joint of arista at least twice as long as broad. 29
Penultimate joint shorter or only slightly longer than broad. 36

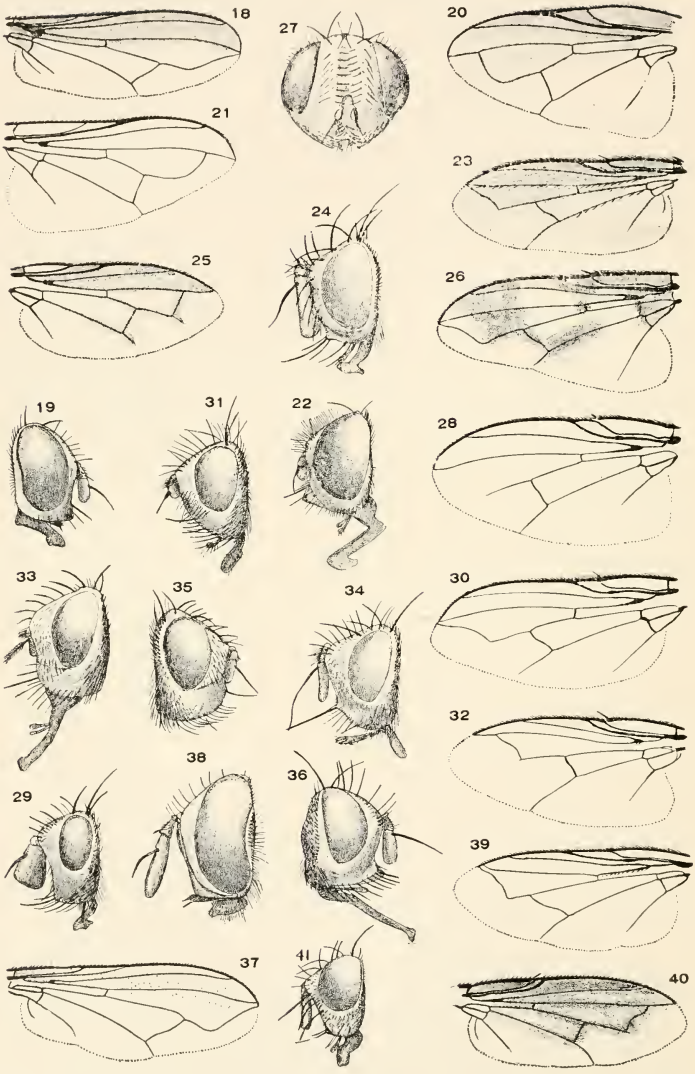


Fig. 149.

29. First vein bare. 31
Firt vein partly or wholly bristly. 30

30. Abdomen with discal and marginal macrochætæ (28, 29). **Euryceromyia.**
Abdomen with marginal bristles only. . . **Plectops.**

31. Palpi subcylindrical, less than half as wide as the proboscis. 32
Palpi flattened and usually wider than the proboscis. **Lispidea.**

32. Third vein at most with four bristles near origin. . . 33
Third vein bristly nearly to anterior cross-vein (14). **Thryptocera**

33. Arista slender on distal half; third antennal joint entire. . 34
Arista distally thickened; third antennal joint divided longitudinally in the male. . . . . **Schizotachina.**

34. Abdomen with discal macrochætæ. 35
Abdomen without discal macrochætæ (15). . **Clausicella.**

35. Two sternopleural bristles. . . . . **Næra.**
Three sternopleural bristles. . . . . **Medina.**

36. Palpi absent or vestigial. 37
Palpi well developed. 39

37. Horizontal diameter of head at vibrissæ as great as at base of antennæ. . . . . **Apinops.**
Head much shorter at vibrissæ than at antennæ. . . 38

38. Facial ridges bristly almost to middle. . **Pseudapinops.**
Facial ridges almost wholly bare (63, 64). . . **Ervia.**

39. First vein bare. 44
First vein partly or wholly bristly. 40

40. Eyes bare or with indistinct, short, sparse hairs. . . 41
Eyes distinctly hairy. . . . . **Hypochæta.**

41. Diameter of head at vibrissæ as great as at root of antennæ. 42
Head shorter at vibrissæ than at root of antennæ. **Chætophleps**

42. Arista pubescent, the longest hairs scarcely half as long as the greatest diameter of arista. 43
Arista bearing short hairs, the longest of which are slightly longer than the greatest diameter of arista. . **Leskiomima.**

43. Frontal vitta next the antennæ nearly four times as wide as either side of front; third vein not bristly to anterior cross-vein; scutellum with two pairs of marginal macrochætæ. **Lasioneura.**
Frontal vitta next the antennæ at most twice as wide as either side of the front; third vein bristly almost to the tip; scutellum with three pairs of marginal macrochætæ. . . . **Actia.**

Fig. 149. Tachinidæ. 18, 19, *Acaulona costata*, wing, head; 20, *Alophora fumosa*, wing; 21, *Phorantha*, sp wing. head; 25, *Euscopolia dakotensis*, wing; 26, 27, *Oestrophasia calva*, wing, head; 28, 29, *Enceromyia robertsoni*, wing (bristles omitted from base of first vein, and small costal spines), head; 30, 31, *Phyto clesides*, wing, head; 32, 33, *Rhinophora mexicana*, wing, head; 34, *Cryptomeigenia eumyothyroides*, head; 35, *Myiophasia ænea*, head; 36, *Anisia*, sp. head; 37, 38' *Hemyda aurata*, wing, head; 39, *Elaphipalpus*, sp. wing: 40, 41, *Metachæta atra*, wing (bristles omitted from first and third veins), head.

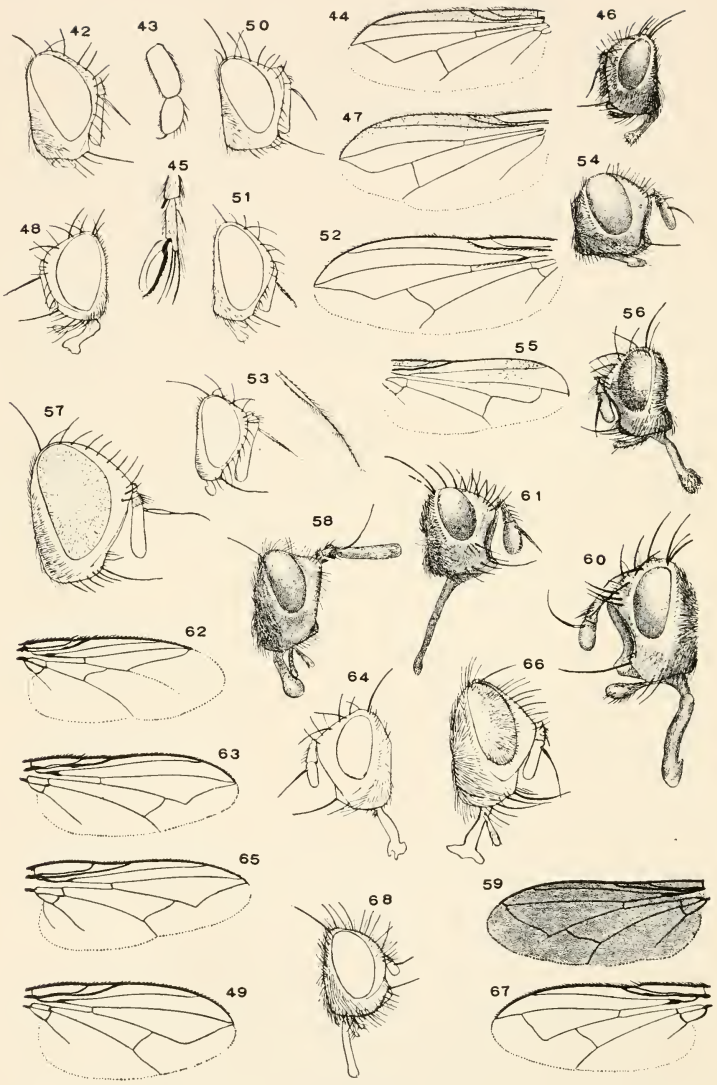

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Fig. 150.

44. Eyes distinctly hairy. 45
Eyes bare, or with indistinct, short, sparse hairs. . . 50

45. Frontal bristles usually not descending below base of second antennal joint; abdomen largely or wholly opaque gray pollinose. 46
Frontal bristles descending below middle of second antennal joint. 48

46. Cheeks nearly as broad as the height of eyes. **Hyalurgus,***
Cheeks less than one-half as broad as eye-height. . , 47

47. Third vein bristly to anterior cross-vein. . **Ptilodegeeria.**
Third vein not bristly to anterior cross-vein (65). **Macquartia.**

48. Body shining, without pollen. . . . . **Polidea.**
Body partly or wholly opaque pollinose. 49

49. Hind tibiæ outwardly fringed with nearly equal bristles. **Metachæta.**
Hind tibiæ fringed with unequal bristles (51). . **Didyma.**

50. Sides of face at narrowest part at most one-third as wide as the median depression. 52
Sides of face one-half as wide as median depression. . . 51

51. Fourth vein obliterated beyond the bend. . **Racodineura.**
Fourth vein not obliterated beyond bend. . . . **Clista.**

52. Head at vibrissæ shorter than at root of antennæ. . . 55
Head at vibrissæ as long as at root of antennæ. . . . 53

53. Arista pubescent (112). . . . . **Leskia.**
Arista not pubescent. 54

54. Abdomen elliptical, conical or ovate (36). . . . **Anisia.**
Abdomen rounded. . . . . **Sphærina.**

55. Horizontal diameter of the occiput above the neck, less than one-half as great as that of the eye. 56
Horizontal diameter of the occiput above the neck as great as that of the eye; antennæ reaching at least the lowest fifth of the face; vibrissæ on a level with oral margin (compare Hypostena). **Pelatachina.**

56. Front of male destitute of orbital bristles; venter of female abdomen without short spines; third vein with at least two bristles near its origin. . . . . **Hypostena.**
Front in both sexes with orbital bristles. 57

* *H. Johnsoni* is a true *Macquartia;* I have examined the type.—W.

Fig. 150. Tachinidæ. 42, *Atrophopoda braueri*, head; 43, id. front tarsus of female; 44, *Vanderwulpia townsendi*, wing; 45, *Atrophopoda braueri*, front tarsus of male; 46, *Eucnephalia goniodes*, head; 47, *Beskia cornuta*, wing; 48, 49, indet.; 50, *Phorocera puer*, head· 51, *Didyma calyptra*, head; 52, *Atrophopoda braueri*, wing; 53, *Vanderwulpia townsendi*, head and arista; 54, *Ocyptera* sp. head; 55, *Sciasma nebulosa*, wing; 56, *Gymnochæta* sp. head; 57, *Exorista nobilis*, head; 58, 59, *Penthosia satanica*, head, wing; 60, *Paradejeania*, sp. (Brazil), head; 61, *Etachipalpus*, sp. head; 62, *Heteropterina nasoni*, wing; 63, 64, *Ervia triquetra*, wing, head; 65, 66, *Macquartia pristis*, wing, head; 67, 68, *Leucostoma senilis*, wing, head.

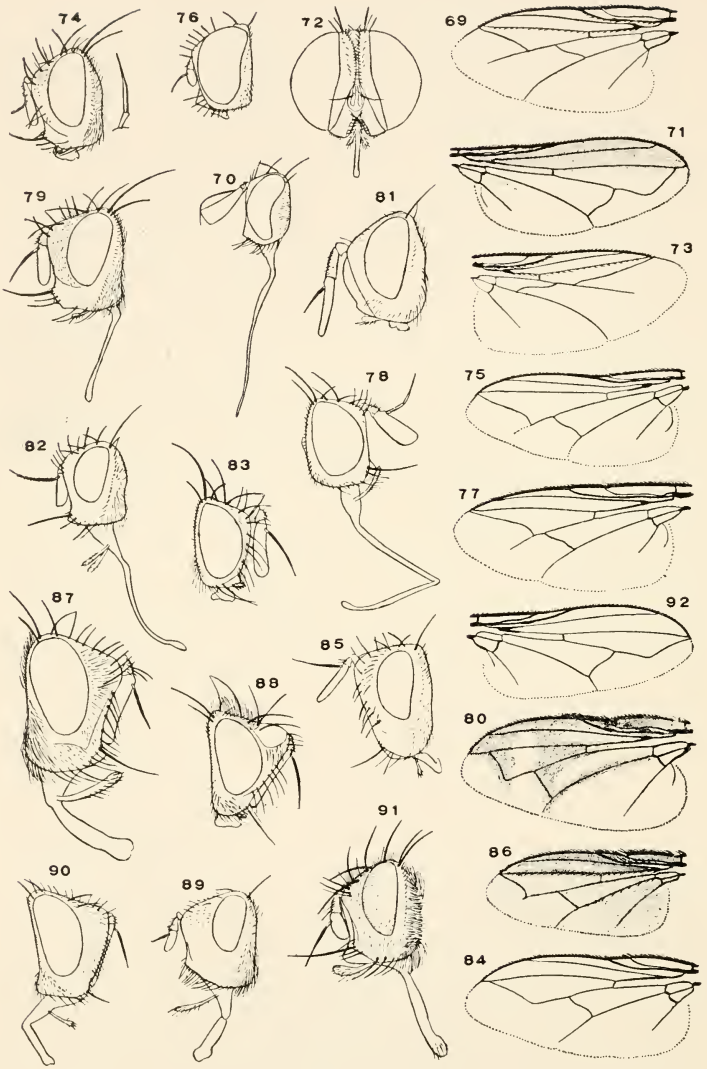

Fig. 151.

57. Second abdominal segment of female with many short spines beneath. . . . . **Celatoria.**
Venter without such spines. . . . . **Myothiria.**

58. Apical cell open, or with a petiole less than one-half as long as the posterior cross-vein. 62
Apical cell closed. 59

59. Abdomen cylindrical or subcylindrical, nearly twice as long as wide, second and third segments without discal macrochætæ. 60
Abdomen subhemispherical, only slightly longer than broad, the second and third segments with discal macrochætæ. **Hyalomyodes.**

60. Ocellar bristles present. 61
Ocellar bristles wanting (present in *X. arcuata*). **Xanthomelana**

61. Ocellar bristles curving backward; anterior cross-vein about even with tip of first vein (**67, 68**). . . **Leucostoma.**
Ocellar bristles curving forward; anterior cross-vein far beyond tip of first vein (**55**). . . . . **Sciasma.**

62. Head at vibrissæ shorter than at base of antennæ. . . 63
Head at vibrissæ as long as at base of antennæ. . . . 66

63. Occiput at most only slightly convex; body short and robust. 64
Occiput strongly convex; body elongate. **Eutrixa** (Vanderwulpia).

64. Root of antennæ below middle of eyes. 65
Root of antennæ above middle of eyes. . **Eumyothyria.**

65. Eyes hairy. . . . . **Myiopharus.**
Eyes bare (**26, 27**). . . . . **Oestrophasia.**

66. Body short and robust. 67
Body elongate and slender; apical cell short petiolate (**71, 76**). **Xanthomelana.**

67. Antennæ not reaching below the lowest third of face; frontal bristles usually not descending below base of second antennal joint. 69
Antennæ reaching to or below the lowest fifth of face; frontals usually descending below base of second antennal joint. 68

68. Third vein with two or three bristles near origin (**26, 27**). **Oestrophasia.**
Third vein with but one bristle near origin. . . **Dionæa.**

69. Head more than twice as high as long; occiput at most only slightly convex (**26, 27**). . . . . **Oestrophasia.**
Head about one and one-third times as high as long; occiput usually strongly convex. 70

Fig. 151. Tachinidæ. 69, *Siphoplagia anomala*, wing; 70, *Beskia cornuta* head; 71, *Xanthomelana arcuata*, wing; 72, *Pachyophthalmus floridensis*, head; 73, 74, *Goniochæta plagiodes*, wing, head; 75, *Pachyophthalmus floridensis*, wing; 76, *Xanthomelana arcuata*, head; 77, *Linnæmyia*, sp. wing; 78, *Siphona geniculata*, head; 79, *Siphoplagia anomala*, head; 80,81, *Euthera tentatrix*, wing, head; 82, *Epigrimyia lucens*, head; 83, *Chætoplagia aterrima*, head; 84, 85, *Euthyprosopa petiolata*, wing, head; 86, *Chætoplagia aterrima*, head; 87, *Chætogædia analis*, head; 88, *Metopia luggeri*, head; 89, *Melanophrys insolita*, head; 90, *Opsidia gonioides*, head; 91, *Hystricia pollinosa*, head; 92, *Clytiomyia flava*, head.

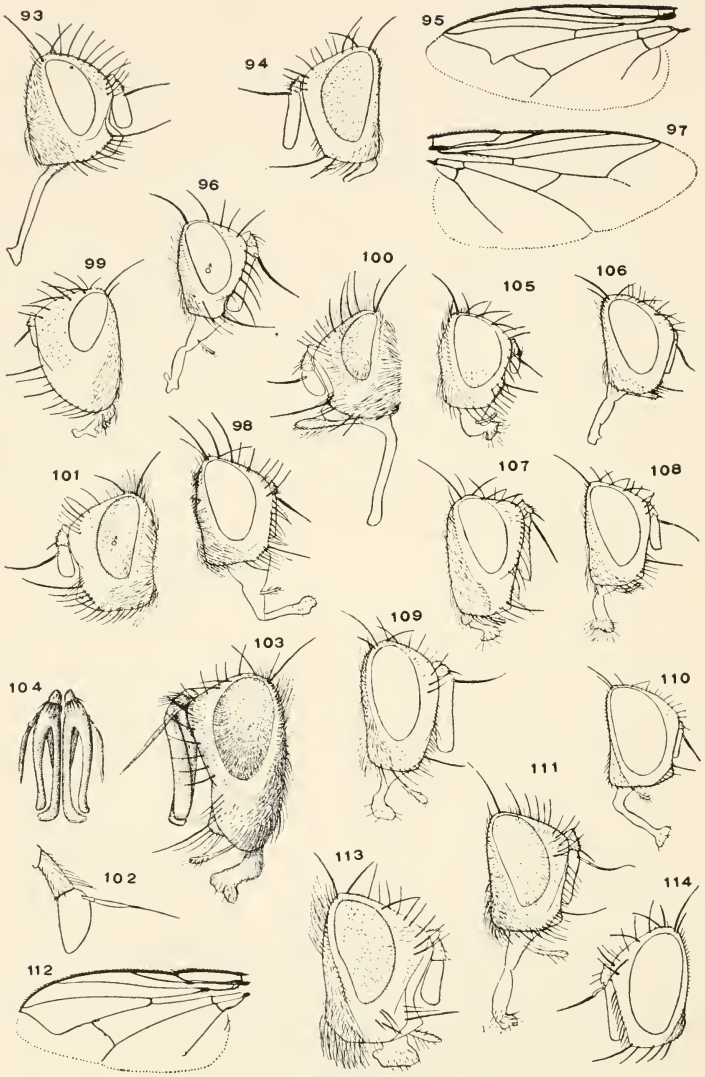
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Fig. 152.

70. Eyes descending below vibrissæ. . . . . **Telothyria.**
Eyes not descending below vibrissæ. . . . **Clytiomyia.**

71. Palpi absent (**70**). . . . . **Beskia.**
Palpi present. 72

72. First vein partly bristly. 73
First vein bare. 74

73. Two orbital bristles in the male; apical pair of scutellar bristles long. . . . . **Ginglymyia.**
No orbital bristles in the male; apical pair of bristles short (**32**). **Epigrimyia.**

74. Proboscis not geniculated near middle. 75
Proboscis geniculated near middle (**78**). . . **Siphona.***

75. Facial ridges bristly on at least the lower half. . **Isoglossa.**
Facial ridges never bristly on more than the lowest fifth (**82**). **Epigrimyia.**

———o———

76. Last section of fifth vein or its fold more than one-half as long as the preceding. 77
Last section of fifth vein not more than one-third the length of the preceding. 88

77. First vein wholly or partly bristly. 78
First vein bare. 81

78. Head at vibrissæ as long as at base of antennæ. . . 79
Head at vibrissæ shorter than at root of antennæ (**8**). **Plagia.**

79. Fifth vein bristly. . . . . **Plagiomima.**
Fifth vein bare. 80

80. Sides of face with strong bristles. . . . **Goniochæta.**
Sides of face with short, scattered hairs (**79**). **Siphoplagia.**

81. Sides of face on lower half bare. 82
Sides of face with macrochætæ or bristly hairs on at least a portion of lower half. 85

82. Facial ridges bristly on their lowest third only. . . 83
Facial ridges bristly at least to their upper third. . . 84

83. First posterior cell closed in the margin (**62**). **Heteropterina.**
First posterior cell long petiolate (**25**). . . **Euscopolia.**

* Bezzi would call this genus *Bucentes* Lat.; see Muscidæ.

Fig. 152. Tachinidæ. 93, *Demoticus venatoris*, head; 94, *Hyphantrophaga hyphantriæ*, head; 95, *Jurinia hystricosa*, wing; 96, *Paradidyma*, sp.; 97, 98, *Plagiprospherysa parvipalpis*, wing, head: 99, *Micropthalma disjuncta*, head; 100, *Jurinella ambigua*, head; 101, *Nemoræa nigricornis*, head; 102, *Archytas apicifera*, antenna; 103, *Dichocera lyrata*, head; 104, *Dichocera lyrata*, antennæ from in front; 105, *Muscopteryx*, sp. head; 106, *Hilarella decens*, head; 107, *Neotractocera*, sp., head; 108, *Pseudotractocera neomexicana*, head: 109, *Frontina archippivora*, head; 110, *Senotainia rubriventris*, head; 111, *Gædiopsis mexicana*, head; 112, *Leskia analis*, wing; 113, *Bombyliomyia abrupta*, head; 114, *Chætoglossa picticornis*, (the long, slender proboscis omitted) head.

84. Cheeks about one-fourth or less of eye-height (**97, 98**). **Plagiprospherysa.**
Cheeks nearly as broad as eye-height. . . **Baumhaueria.**

85. Eyes bare, or with indistinct hairs. 86
Eyes distinctly hairy. . . . . **Cyrtophlœba.**

86. Sides of face without stout macrochætæ. . . . 87
Sides of face with one or more pairs of macrochætæ. **Paraplagia.**

87. Arista thickened almost to its tip; third vein bristly nearly to anterior cross-vein. . . . . **Metaplagia.**
Arista not thickened to the middle; third vein bristly less than half way to the cross-vein (**62**). . . **Heteropterina.**

88. Sides of face bare on lower half. 89
Sides of face with hairs. 140

89. Vibrissæ distinctly above oral margin. 91
Vibrissæ on a level with oral margin. 115
Vibrissæ very vestigial. 90

90. Wings nearly wholly brownish black; black species (**58, 59**). **Penthosia.**
Wings brownish anteriorly only. . . . **Clinogaster.**

91. Eyes bare. 92
Eyes hairy. 109

92. Penultimate joint of arista more than twice as long as broad. 93
Penultimate shorter or only slightly longer than broad. . 94

93. Proboscis beyond basal articulation at most one and two-fifths times the height of head (**2**). . . . . **Aphria.**
Proboscis beyond basal articulation at least two and one-third times the height of head (**114**). . . **Chætoglossa.**

94. Palpi absent or vestigial (**54**). . . . . **Ocyptera.**
Palpi present. 95

95. Proboscis beyond basal articulation at least one and one-third times the height of head (**2**). . . . . **Aphria.**
Proboscis beyond basal articulation at most one and one-fifth times the height of head. 96

96. Antennæ reaching at least the lowest fourth of face. . . 105
Antennæ not reaching below the lowest third. . . . 97

97. Vibrissæ at less than half the length of the second antennal joint above the oral margin. 98
Vibrissæ at least the length of the second joint above the oral margin. 99

98. Lowest frontal bristles not below the base of the second antennal joint (**72, 75**). . . . . **Pachyophthalmus.**
Lowest frontals below the middle of second antennal joint (**6**). **Atacta.**

99. Lowest frontals below middle of second antennal joint. . 100
Lowest frontals not below middle of second joint. . . 103

100 Ocellar bristles directed forward. 101
Ocellar bristles wanting. . . . . **Belvosia.**

101. Hind tibiæ not with distinct cilia externally. . . . 102
Hind tibiæ ciliated externally; apical cell open (6). **Atacta.**

102. Apical cell open. . . . . **Biomyia.**
Apical cell closed (108). . . . **Pseudotractocera.**

103. Cheeks less than one-third as broad as eye-height; arista thickened almost to tip (89). . . . **Melanophrys.**

104. Frontal bristles in two rows (110). . . . **Senotainia.**
Frontal bristles in four rows (72, 75). **Pachyophthalmus.**

105. Vibrissæ at most only one-half the length of second antennal joint above oral margin. 108
Vibrissæ at least the length of second antennal joint above oral margin. 106

106. Ocellar bristles directed forward. 107
Ocellar bristles wanting. . . . . **Belvosia.**

107. Hind tibiæ externally ciliated (6). . . . . **Atacta.**
Hind tibiæ not ciliated. . . . . **Biomyia.**

108. Lower frontal bristles below base of second antennal joint. **Siphosturmia.**
Lowest frontals not below base of second joint (89). **Melanophrys.**

109. Palpi absent or vestigial (77). . . . . **Linnæmyia.**
Palpi present. 110

110. Sides of face at narrowest part less than one-third the width of the median depression. 114
Sides of face half as wide as the median depression, or more. 111

111. Dorsum of abdomen without macrochætæ. **Mystacomyia.**
Dorsum of abdomen with macrochætæ. 112

112. Face in profile convex. . . . . **Macromeigenia.**
Face in profile perpendicular. 113

113. Abdomen with marginal macrochætæ only. . **Bolomyia.**
Abdomen with discal and marginal macrochætæ. **Paramesochæta.**

114. Bend of fourth vein with a long appendage; second and third segment of abdomen usually without discal macrochætæ (101). **Nemoræa;**
Bend of fourth vein at most with an extremely short appendage. second and third segments of abdomen with discal macrochætæ. **Panzeria.**

115. Eyes hairy. 116
Eyes bare. 121

116. First vein with two or more bristles on outer half. **Exoristoides.**
First vein bare. 117

117. Abdomen bright or bluish green; facial ridges never bristly on more than the lowest fourth (56). . . **Gymnochæta.**
Abdomen black or more or less yellow. 118

118. Facial ridges not bristly on more than the lower half. . 119
Facial ridges bristly on at least the lower two-thirds. . 120

119. Sides of face at narrowest part less than one-third the width of the median depression (fig. 147). . . . **Exorista.**
Sides of face more than one-half the width of the median depression. . . . . **Metaphyto.**

120. Bend of fourth vein with a long appendage or distinct fold. **Euphorocera.**
Bend of fourth vein without such fold or appendage. **Phorocera.**

121. First vein bristly except at tip and base. . . . **Houghia.**
First vein bare. 122

122. Facial ridges not bristly on more than lower half. . . 123
Facial ridges bristly on the lower two-thirds. **Pseudochæta.**

123. Antennæ reaching at least the lowest fourth of face. . 126
Antennæ not reaching below lowest third. . . . 124

124. Vibrissæ less than one-half the length of the second antennal joint above oral margin. 125
Vibrissæ at least the length of the second antennal joint above oral margin (5). . . . . **Acemyia.**

125. Third vein with a single bristle at its origin. . **Comatacta.**
Third vein bristly more than one-half the distance to anterior cross-vein. . . . . **Paraphyto.**

126. Lowest frontals below base of second antennal joint. . 129
Lowest frontal not below base of second antennal joint. . 127

127. Facial depression without median carina. . . . 128
Facial depression with a carina; apical cell closed, the petiole twice the length of anterior cross-vein (80, 81). **Euthera.**

128. Lower anterior corner of third antennal joint produced tooth-like (5). . . . . **Acemyia.**
Antennæ not so produced (44, 53). . **Vanderwulpia.**

129. Second abdominal segment without more than four marginal macrochætæ; or, if with more; the hind tibiæ not ciliate. 130
Second abdominal segment with at least six marginal macrochætæ (4). . . . . **Blepharipeza.**

130. Hind tibiæ ciliated externally. 131
Hind tibiæ not ciliated externally. 135

131. Facial ridges bristly almost to the middle. . . . 133
Facial ridges bristly on less than the lowest fourth. . 132

132. Bristles of cheeks covering at least the lower two-thirds. **Sturmia**
Bristles of cheeks covering less than the lower half (94). **Hyphantrophaga.**

133. Frontals with at least three backwardly directed bristles in each row; abdomen largely or wholly opaque pollinose. . 134
With only two such bristles in each row; abdomen shining. **Parachæta.**

134. With two or three backwardly curved bristles outside of the frontal rows. . . . . **Pseudochæta.**
Front without such macrochætæ (109). . . **Frontina.**

135. Bend of fourth vein without appendage. 137
Bend of fourth vein with appendage or distinct fold. . 136

156
Near Equalbus
(Brazil)

157
Near Fabricia
Brazil

158
Belvosia

136. Arista distinctly pubescent; facial ridges bristly on the lower five-sixths. . . . . Prospherysa.
Arista bare; facial ridges at most bristly on lower three-fifths (9). Tachina.

137. Diameter of head at vibrissæ as great as at root of antennæ. 138
Head much shorter at vibrissæ than at base of antennæ. 139

138. Facial ridges bristly on at least the lower two-thirds. Tachinopsis.
Facial ridges bristly on less than the lowest third (93). Demoticus.

139. Lower front corner of third antennal joint produced tooth-like (5). Acemyia.
Lower front corner not so produced (1). . . Masicera.

140. Vibrissæ on a level with oral margin. 141
Vibrissæ disiinctly above the oral margin. . . . 161

141. First vein wholly or partly bristly. 142
First vein bare. 143

142. Apical cell open (83). . . . . Chætoplagia.
Apical cell closed and long petiolate (40, 41). Metachæta.

143. Eyes distinctly hairy. 144
Eyes bare, or with short, indistinct hairs. . . . 146

144. Sides of face without macrochætæ. . . . Winthemia.
Sides of face with macrochætæ, at least near lower end of eye. 145

145. Third joint of antennæ at least five times the length of the second. Paradidyma.
Third joint scarcely as long as the second (105). Muscopteryx.

146. Apical cell closed. 147
Apical cell open; if closed, the petiole less than one-fifth the length of the hind cross-vein. 149

147. Frontals not, or scarcely descending below base of antennæ. 148
Frontal descending considerably below base of antennæ. Phorichæta.

148. Proboscis two and one-half times the height of the head. Trochilodes.
Proboscis short, not longer than height of head. Miltogramma.

149. Facial ridges bristly on at least the lower half. . Araba.
Facial ridges bristly on less than lower half. . . . 150

150. Antennæ reaching only slightly below middle of face. . 151
Antennæ reaching to or below lowest fourth. . . . 153

151. Apical cell open. 152
Apical cell closed, the petiole as long as the anterior cross-vein. Euthyprosopa.

152. Hind tibiæ fringed externally with bristles of equal length. Thysanomyia.
Bristles of hind tibæ of unequal length. . Brachycoma.

153. Face with macrochætæ, at least near lower end of eye. . 154
Sides of face without macrochætæ. 160

154. Head at vibrissæ as long as at base of antennæ. . . 155
Head at vibrissæ much shorter than at base of antennæ. 157

155. Posterior cross-vein much nearer to bend of fourth vein than to the anterior cross-vein. 156
Posterior cross-vein at most only slightly nearer to bend of fourth vein than to anterior cross-vein. . . . Trichogena.

156. Fifth vein not reaching the hind margin (39, 61). Elachipalpus.
Fifth vein reaching the hind margin. . Brachycoma.

157. Facial ridges almost parallel; sides of face at narrowest part nearly as wide as the median depression. . . . 158
Facial ridges widely diverging below; sides of face less than one-half as wide as median depression. 159

158. Fifth vein not reaching the wing margin (39, 61). Elachipalpus.
Fifth vein reaching the wing margin (90). . Opsidia.

159. Fifth vein not reaching the wing margin (39, 61). Elachipalpus.
Fifth vein reaching the wing margin (88). . Metopia.

160. Head at vibrissæ much shorter than at root of antennæ. Hilarella.
Head at vibrissæ as long as at root of antennæ. Brachycoma.

161. Head at vibrissæ much shorter than at root of antennæ. 162
Head at vibrissæ as long or longer than at root of antennæ. 168

192. Eyes distinctly hairy. 163
Eyes bare or with very short hairs. 164

163. Facial ridges not bristly on more than lowest fifth; antennæ of male divided longitudinally (103, 104). Dichocera.
Facial ridges bristly on at least the lower half (111). Gædiopsis.

164. Ocellar bristles wanting (99). . . . Microphthalmia.
Ocellar bristles present. 169

165. Ocellar bristles directed backward, robust. . . . 166
Ocellar bristles directed forward. 167

166. Front opaque, the vitta deep brown or black (3). Spallanzania.
Front shining, the vitta light yellow (12, 13). . Gonia.

167. Frontal ridges bristly on less than the lowest fourth (99). Microphthalmia.
Frontal ridges bristly on at least the lower half (87). Chætogædia.

168. Palpi absent or vestigial. 169
Palpi well developed. 175

169. With one or more stout macrochætæ on either side near lower end of eye. 172
Without such macrochætæ. 170

170. Abdomen with discal macrochætæ. 171
Abdomen without discal macrochætæ. . . Gymnomma.

171. One discal and one marginal pair of macrochætæ on second abdominal segment. . . . . Parepalpus.

With more than one discal and marginal pairs of macrochætæ on second abdominal segment. . . . . **Epalpus.**

172. Sides of face with one macrochætæ; slender (**39, 61**). **Tricophora.**
Sides of face with two or three macrochætæ. **Cuphocera.**

173. Face on lower half of its sides bare (**113**). **Bombyliomyia.**
At least a portion of sides of face with hairs or macrochætæ. 174

174. Eyes distinctly hairy. 175
Eyes bare or with very short hairs. 176

175. Third antennal joint almost straight on front edge, the tip subtruncate (**113**). . . . . **Bombyliomyia.**
Third antennal joint strongly convex on front edge, the tip rounded (**100**). . . . . **Jurinella.**

176. Ocellar bristles absent. 171
Ocellar bristles present. 181

177. Sides of face without macrochætæ. 178
Sides of face with two or three macrochætæ (**7**). **Pelateria.**

178. Second segment of abdomen never with more than eight marginal macrochætæ (**11, 102**). . . . **Archytas.**
Second segment with at least twelve marginals. . . 179

179. Palpi gradually thickened from base; proboscis shorter than height of head. 180
Palpi thickened on distal three-fourth; proboscis at least one and one-third times the height of head (**17**). . . **Dejeania.**

180. Abdomen subquadrate, the tip deeply emarginate (fig. 21, p. 44). **Paradejeania.**
Abdomen conical, the tip not emarginate (**95**). . **Jurinia.**

181. Vibrissæ at least the length of the second antennal joint above oral margin (**46**). . . . **Eucnephalia, Amobia.**
Vibrissæ at most only half the length of the second antennal joint above the oral margin. 182

182. First posterior cell closed. . . . . **Trochilodes.**
First posterior cell open. . . . . **Echinomyia.**

Owing to doubt of their true position, the following genera have not been included in the above table. The references to them will be found in Aldrich's catalogue:

Eliozeta, Himantostoma, Hemithrixion, Meriana, Parahypochæta, Metadoria, Evibrissa, Besseria, Peteina, Masistylum, Stevenia, Mystacella, Chætogena, Hypertrophocera, Tricolyga, Tetragrapha, Dæochæta, Neotractocera (**107**), *Paragædia, Cestonia, Gædiophana, Cryptopalpus, Hystricia. Microchira, Tropidopsis.*

NOTES.

BY PROF. C. H. T. TOWNSEND.

These notes are given in advance of a forthcoming paper, which will give characterization of new, and reasons for maintaining certain old genera and species mentioned herein, besides pointing out distinctions between various forms. When characters are given for species, unless otherwise stated, it is to be understood that the same have been drawn from specimens in the United States National Museum, after comparison with the figures.

Fig. 1. The American species is probably not *festinans*.

Fig. 2. The figures agree perfectly with type and cotype in the National Museum.

Fig. 3. *Cnephalia pansa*. The figure is apparently made from a male specimen, but does not show the characters clearly. The third antennal joint is too long, the second too short. After a careful comparison of European and American specimens, I am convinced that *Spallazania hebes* does not occur in America.

Fig: 4. *Rileymyia adusta*. The genus should be maintained.

Fig. 5. The type, a female, has the third antennal joint just twice as long as the second. The eyes descend almost as low as the vibrissæ.

Fig. 6. *Atacta*, sp. Not typical of *Atacta*, which has cheeks wider, appearing one-fifth of eye-height from side view; second antennal joint strongly elongate; antennæ inserted rather below middle of eyes.

Fig. 8. *Plagia aurifrons*. This appears to be the wing of *P. aurifrons*, which is distinct from *americana*.

Fig. 9. *Tachinomyia robusta* female. The figure does not show vibrissal insertion high enough, nor the cheeks wide enough.

Fig. 10. *Gymnoclytia immaculata*. This species is not congeneric with the European *Cistogaster globosa*.

Fig. 11. *Archytas lateralis*. Ptilinal suture apparently omitted; a bristle from opposite side of front included.

Fig. 12, 13. *Gonia frontosa*. Not *G. capitata*, which has second aristal joint about as long as the third. Although the lengths of the aristal joints are variable in *Gonia*, they do not vary so much as to invalidate their usefulness.

Fig. 14. *Clausicella* sp. Not typical of *Thryptocera*. The epistoma is not so prominent in *Thryptocera*, the frontal bristles are stronger, aristal joint is proportionally longer.

Fig. 16. *Argyromima setigera*. Not typical of *clausicella*, which has apical cell closed.

Fig. 18, 19. *Acaulona cristata*. The apical cell is sometimes short petiolate.

Fig. 20. *Alophora fumosa*. Agrees with type. Not very typical of *Alophora*, but best referred here provisionally.

Fig. 21. *Hyalomyia*, sp. Typical wing, not *Phorantha*.

Fig. 22. *Alophora*, sp., not *Phorantha*.

Fig. 25. *Euscopolia dakotensis*. Third vein is bristly more than half way to cross-vein.

Figs. 30, 31. *Neophyto setosa*. Is not a *Phyto*. I propose to call the genus *Neophyto*, and will give full details elsewhere.

Figs. 32, 33. *Rhinophora mexicana*. Small cross-vein lacking. The fourth vein of *Rhinophora* is normally not represented by a stump beyond apical cross-vein, but by a wrinkle.

Fig. 34. *Euphantopteryx eumyothyroides;* is not *E. theutis* Walk.

Fig. 35. *Phasioclista*, sp. female.

Fig. 36. *Anisia* sp. This genus, to be employed at all, will have to be restricted to species of some particular type. The genus as originally established includes many diverse forms.

Figs. 39, 61. *Copecrypta ruficauda*, new genus.

Figs. 40, 41. *Metachæta atra*. Apparently this species, though the type in the National Museum has the apical cross-vein only very slightly, almost imperceptibly bisinuate.

Figs. 42, 43, 45 and 52. *Diaphoropeza braueri*, new genus.

Figs. 44, 53. *Oedimapeza townsendi*. This and the preceding species are not congeneric, and neither one can be referred to *Vanderwulpia* or *Atrophopoda*. I propose the former name for *braueri* and the latter for *townsendi*, and they will be described elsewhere.

Fig. 46. *Eucnephalia gonioides*. The arista is shorter than the third antennal joint; there are weak bristles on the wide parafacials, and the facialia are bristly more than half way up.

Fig. 50. Not a true *Phorocera*, nor can it be referred to *Plagiprosopherysa* or *Prosopodes*.

Fig. 51. *Didyma calyptrata*. Not a true *Didyma*, for which *D. albombicans* Wulp should be taken as the type.

Fig. 55. *Sciasma nebulosa*. Small cross-vein about midway between hind cross-vein and end of first vein.

Fig. 56. Frontal bristles usually descend to insertion of arista.

Fig. 57. *Parexorista nobilis*.

Figs. 63 and 64. *Paranophora diademoides*. This is not *Ervia triquetra* of Olivier, nor of Robineau Desvoidy, nor does it belong to *Ervia* Desv. It is, however, the species so determined by Coquillett. The frontal bristles descend one bristle lower.

Figs. 65, 66. *Aporia limacodis*. This is a true *Aporia*, not a *Macquartia*. The head is that of a female. *Dexia tristis* Walk. seems to be an *Aporia*, but quite impossible to identify from the description.

Figs. 67, 68. The figures agree with a male cotype of *Leucostoma nigricornis*, except that the third antennal joint should be the same length as the second. I consider *nigricornis* and *senilis* distinct and will give reasons elsewhere.

Figs. 69, 79. *Siphoplagia anomala*. First vein bristly to opposite end of auxiliary, and third vein to opposite origin of apical cross-vein.

Figs. 71 and 76. *Xanthomelanodes arcuata.* Figure evidently made from an oblique viewpoint. *Xanthomelana* is preoccupied in Aves (Bonaparte, 1850).

Figs. 72, 75. *Sarcomacronychia*, sp. Not *Pachyophthalmus.* I five elsewhere distinctive differences.

Figs. 73, 74. *Goniochæta plagiodes.* A small costal spine sometimes. The frontal and parafacial bristles usually appear as a continuous row, the latter directed downward. The foremost frontali inserted opposite base of third joint. There are three proclinate orbital bristles in each sex, the middle ones sometimes weak.

Fig. 78. *Siphona illinoisensis.* Differs from *geniculata* in the widened and flattened third antennal joint, convexity of third aristal joint, etc.

Figs. 80, 81. *Euthera tentatrix.* The second antennal joint is sometimes almost as long as the third, the latter in such case being shortened so as to make the antennæ scarcely longer than face. The third joint is normally of equal width throughout; truncate at tip.

Fig. 82. *Drepanoglossa lucens.* The anterior upper fronto-orbital (reclinate) bristle is stronger than any other save the vertical. I give elsewhere the differences between *Epigrimyia* and *Drepanoglossa.*

Figs. 84, 85. *Euthyprosopa petiolata.* Compared with cotype the front pair of ocellar bristles is longer than shown in figure, and third antennal joint is pointed at apex. The frontal bristles are shorter. The hind cross-vein may be nearer the angle of the fourth vein in some specimens than in others.

Fig. 87. *Chætogædia acroglossoides.* Apparently the male of *Frontina acroglossoides* Towns. I give elsewhere distinctions between this species and *Baumhaueria analis* Wulp, with notes on *Chætogædia*, and an allied new genus. The figure should show the outer row of frontal bristles differentiated from the bristly hairs of parafrontals and the second antennal joint longer to agree with eastern specimens which I am inclined to identify as this species.

Fig. 89. *Atropharista jurinoides.* I give reasons elsewhere for maintaining this genus.

Fig. 91. *Eujurinia pollinosa.* I propose this name for *Hystricia pollinosa* Wulp. A specimen from Mexico differs from the figure in the somewhat wider cheeks and the not bowed palpi.

Fig. 92. *Euclytia flava.* I propose the new genus *Euclytia* for *Clytia flava* and give particulars elsewhere.

Fig. 93. *Neofischeria flava* Towns. n. g. et n. sp. The genus and species are characterized elsewhere. This is not *Demoticus venatoris* Coq., which by the way is not a *Demoticus*, and for which I propose the new genus *Parafischeria.* The figure should show the well developed palpi, which are elongate, a little thickened distally and slightly curved.

Fig. 94. *Hyphantrophaga hyphantriæ*, male. The parafacials below and the cheeks should be narrower to agree with topotypes in the National Museum.

Figs. 97, 98. *Plagiprospherysa valida*. The parafacials are not so wide below in tototypes in the National Museum. The species is apparently closely allied to *P. parvipalpis*, but needs comparison.

Fig. 100. *Pseudohystricia ambigua*, male. The genus differs from *Jurinella* in the wider parafacials and more produced front.

Fig. 101. *Saundersia* sp? Can not be a *Nemoræa*, which has the epistoma less prominent and the face more receding and lengthened.

Fig. 105. *Muscopteryx* sp. Probably *M. chætosula*.

Fig. 106. Compared with a cotype there is a pair of short reclinate fronto-orbital bristles opposite the ocellar pair, wanting in figure.

Fig. 109. *Achætoneura archippivora*, male. This is *Achætoneura* and not *Frontina*. Notes on the distinction will be published elsewhere.

Fig. 110. *Senotainia flavicornis*. This is distinct from *rubriventris*.

Fig. 111. *Gædiopsis* sp? This may be *mexicana*, but is not the species so determined by Coquillett, which I shall describe as a new genus and species, *Poliophrys sierricola*.

Fig. 112. *Stomatodexia analis*. If *Dexia analis* Say is congeneric with *Dexia diadema* Wied. and the species figured is correctly identified with the former, it is incorrect in having the first posterior cell end so far from the wing tip.

Fig. 113. *Bombyliomyia abrupta*. The arista is longer than the third antennal joint.

Fig. 114. *Chætoglossa picticornis*. The figure lacks the long and extremely delicate proboscis.

National Museum, June, 1907.

LIX. Family HIPPOBOSCIDÆ.

Fig. 159. *Pseudolfersia fumipennis*, enlarged. After Lugger.

Head flattened, usually attached to an emargination of the thorax; face short; palpi forming a sheath for the proboscis, not projecting in front of the head; antennæ inserted in pits or depressions near the border of the mouth, apparently one-jointed, with or without a terminal bristle or long hairs. Eyes round or oval, ocelli present or absent. Thorax flattened, leathery in appearance; scutellum broad and short. Halteres small or rudimentary. Abdomen sac-like, leathery in appearance, the sutures indistinct. Legs short and strong, broadly separated by the sternum; tarsi short; claws strong and often denticulated. Wings present or absent; the veins always approximated to the anterior border, with less strong ones running obliquely across the wing.

The flies of this family are always parasitic in the adult condition upon birds and mammals; they have a pecu-

liar louse-like appearance, and one often encounters them in handling recently killed birds, especially the raptorial birds. They have a quick, short flight, seeking the beard or hair of the collector within which they run nimbly, seeking to hide. The following table is based chiefly upon Speiser's studies of the genera of the world.

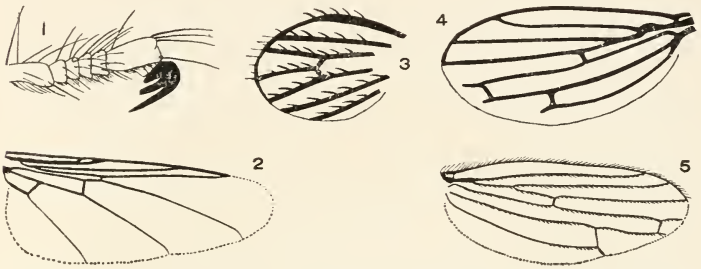

Fig. 160. Hippoboscidæ, Streblidæ. 1, tridentate claw; 2, *Ornithomyia*, wing; 3, *Aspidoptera*, wing (Speiser); 4, *Trichobius*, wing (Speiser, the slight emargination of the distal wing border is not shown); 5, *Strebla*, wing (from specimen from southern Kansas, E. A. Popenoe).

TABLE OF GENERA.

1. Wings functional. 2
   Wings vestigial or wanting. 8
2. Claws simple, that is with no accessory tooth between the enlarged basal plate and the tip. 3
   Claws with an accessory tooth. 4
3. Three longitudinal veins present; wings caducous, often broken and ragged, especially in the female. . . . . **Lipoptena.**
   Six longitudinal veins; wings not caducous. . . **Ornithoica.**
4. Anal cross-vein present, the anal cell complete. . . . 5
   Anal cell open, not closed by a cross-vein. 6
5. Ocelli present (2). **Ornithomyia, Ornithopertha, Ornithoctena.**
   Ocelli absent. . . . . **Stilbometopa.**
6. Wings lanceolate, the tip rounded; scutellum truncate. **Lynchia.**
   Wings of usual shape; scutellum not truncate. . . . 7
7. Distance of oral border from frontal suture as great as from suture to vertex (fig. 159). . . . . **Pseudolfersia.**
   Distance from oral border to suture distinctly less than from suture to vertex. . . . . **Olfersia.**
8. Wings vestigial; halteres present. 9
   Wings and halteres wholly wanting. . . **Melophagus.**
9. Claws simple. . . . . **Lipoptena.**
   Claws with an accessory tooth. . . **Brachypteromyia.**

LX. Family STREBLIDÆ.

Head of moderate size, with a freely movable neck. Eyes, when present, small, unfacetted, or with very few facets. Ocelli wanting. Antennæ inserted in a pit, two-jointed, the second joint with a bristle. Proboscis short, not protrusible, thickened at base. Palpi broader than long, not forming a sheath for the proboscis, *projecting, leaflike in front of the head.* Abdomen with a distinct basal segment, the other segments rarely distinguishable, the first segment with peculiar bristles for the protection of the wings when at rest. Hind coxæ always enlarged; fifth joint of tarsi usually enlarged and elongate. Claws never distinctly toothed; pulvilli present. Wings sometimes wanting or vestigial; when present the surface pubescent and the veins rather stout.

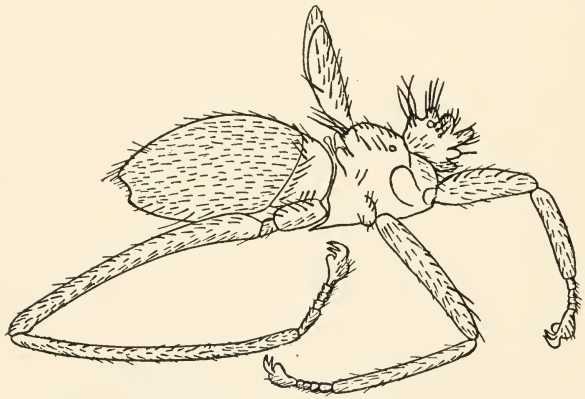

Fig. 161. *Megistopoda* (*Pterellipsis*) *araneæ*, enlarged (Speiser).

The members of this small family of cosmopolitan diptera, are, with the exception of one reported case, exclu-

sively parasitic upon bats. Their breeding habits are not well known. Kolenati believed them to be oviparous, but Speiser is of the opinion that their breeding habits are not unlike those of the Hippoboscidæ.

TABLE OF GENERA.

1. Wings functional, with six longitudinal and nearly parallel veins and three outer cross-veins. 2
   Wings vestigial or wanting, not functional. 3

2. Thorax distinctly longer than broad; abdomen distinctly segmentated, with two large proximal and three small distal segments; last tarsal joint not remarkably thickened (5). **Strebla.**
   Thorax rounded, but little or not at all longer than broad; abdomen usually indistinctly segmentated; last tarsal joint thickened and elongate (4). . . . . **Trichobius.**

3. Legs of usual length (3). . . . . **Aspidoptera.**
   Hind legs greatly elongated, twice the length of the body (*Pterellipsis*) (fig. 161). . . . . **Megistopoda.**

LXI. Family NYCTERIBIIDÆ.

Small, spider-like, wingless flies. Head oval, folding back when at rest in a groove on the dorsum of the thorax. Antennæ short, two-jointed, the oval terminal joint with bristles inserted in tubercles. Eyes and ocelli vestigial. Thorax depressed, laterally anteriorly with comb-like bristles. Abdomen oval, with more or less distinct segmental scutes. Legs long, the knees at rest prominent above the thorax. Femora broad; tibiæ clubbed or shovel-shaped; metatarsus very long. Halteres pedunculate or sessile, in the latter case often indistinct.

This family includes a considerable number of species, distributed widely in different parts of the world, all of them parasitic upon bats. Various attempts have been made to divide the group into smaller genera, but not with much success, *Nycteribia* being the only well defined genus known. *Penicillidia* differs in the more aborted and sessile halteres, and the species are of larger size, but I doubt its validity.

APPENDIX.

During the printing of this work several genera new to America have been added in recent publications; other changes or additions I have ascertained by the examination of types. The student is requested to insert marginal references in the body of the work wherever such changes or additions should be made.

Page 25, near middle, for 'maxillæ' read mandibles; fourth line from bottom for 'not' read seldom.

Page 28, third line, strike out remainder of sentence beginning 'and it has been said', and see footnote, page 81.

Page 35, Mr. Austen urges the abandonment of the term 'metatarsus', and I quite agree with him that the word, as used, is etymologically incorrect. Whether or not distinctive terms for the different tarsal joints are desirable I do not know, but I suggest the following: *protarsus*, *epitarsus*, *mesotarsus*, *metatarsus*, *onychotarsus*.

Page 41, second line from bottom, for 'Cubital 1, 2' read Medial 1, 2, 3; next line for 'V3, Cubital 3' read VII 1, 2, Cubital 1, 2.

Page 42, fig. 16, read *Thereva*, Therevidæ.

Page 86, last couplet, change to read:

Antennæ 14-jointed; 15 in *Elephantomyia*.
Antennæ 16-jointed; 12 in *Toxorhina*.

Page 91, read **Tanypremna** and **Longurio**.

Pages 112, 114, first and seventh lines, for '*Ablabesimyia*', read *Tanypus;* fifth and fourth lines for '*Tanypus*' read *Protenthes*. Page 114, eighth line, for '*Isoplates*', preoc. read *Tanypus*. These corrections are by Prof. Johannsen.

Page 140, near middle, for 'three' read two.

Page 142, change last two lines to read: Palpi four or five jointed; antennæ eight to twelve jointed, etc.

Page 148, last line, for 'facts' read facets.

Page 155, fifth line, insert twelve to before 'sixteen'.

Page 162, *Misgomyia* Coq. (Proc. Ent. Soc. Wash. 1908, 145). Near *Arthroceras*, four posterior cells; two spurs on hind tibiæ. *M. obscura* Coq.–Va.

Page 163. An examination of the type of *Spania edeta* in the British Museum discloses the fact that it is a true *Ptiolina; Spania* is not known to occur in North America. Footnote on same page, for '*Rupellia*' read *Ruppelia*.

Page 167, second line, insert flagellum of before 'antenna'.

Page 168. Mr. Verrall informs me that the real difference between *Neoexaireta* and *Actina* is the ocular pubescence of the latter. He also adopts the name *Chorisops* Rond. in lieu of *Neoexaireta*.

Page 181, for '**Alisonia**' read **Akronia**, and for '**Acanthina**' preoc. read **Acanthinomyia** Hunter. *Myiochrysa coerulia* is a synonym of *Sargus viridis*, according to Verrall.

Page 180, near bottom, for '**Hamatopota**' read **Hæmatopota**.

Page 185. An examination of the type of *Nothra americana* Big. in Mr. Verrall's cabinet discloses the fact that the species is rightly placed. The venation is quite like that of *Pterodontia*, save that there is only a slight angulation in place of the costal spur. This character, however, is not generic; it is disregarded in *Opsebius*. Mr. Verrall separates the genera by the presence of but a single aristal hair in *Nothra*, three in *Pterodontia*, but considering the differences used in generic separation in this family I think *Nothra* should be suppressed, Same page, for '*Appeleia*' read *Apelleia*.

Page 191, couplet 3, last line, insert often after 'proboscis.'

Page 197, et seq. Asilidæ. The distinction between the Leptogastrinæ and Dasypogoninæ is apparently bridged over by a new genus from Brazil, represented by a specimen in my cabinet, of which a figure is here given. The form is quite intermediate between *Leptogaster* and *Plesiomma*. I am unable to make out the structure of the palpi.

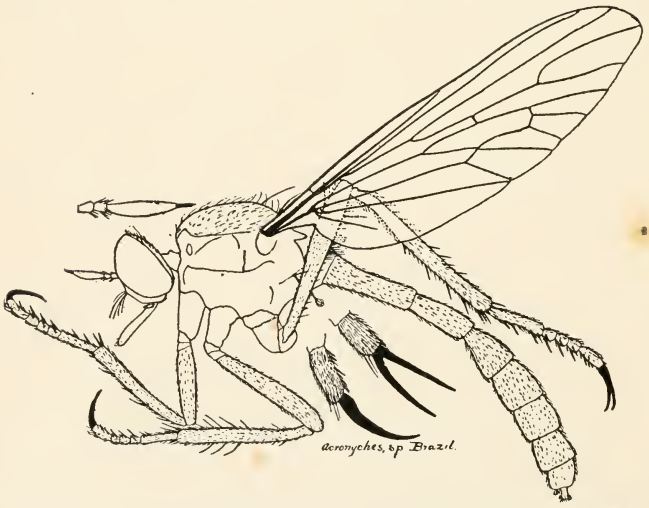

Fig. 163. New genus of Asilidæ between *Leptogaster* and *Plesiomma*.

Dr. Back, who has examined the type of *Sphageus*, distinguishes the genus as follows:

"Front and middle femora with a patch of short, stout bristles below; third antennal joint without excision on inner distal part. **Sphageus.**

Front and middle femora without such patches of bristles; third antennal joint with excision on inner distal part; near the proximal margin of second and third abdominal segments with a white or yellowish pollinose crossband. . . **Dizonias.**"

Dr. Back also has made '*Habropogon*' *bilineatus* the type of a new genus, with the following definition:

"Front not unusually widened above; bristles on the lateral margin and posterior callosities and scutellar margin numerous and well developed; third antennal joint short and broad; species much resembling Stenopogon in general appearance. **Willistonina.**"

Page 195, near middle for '*fraudigera*' read *sabulonum*.

Page 198, couplet 7, third line, for '7' read 8; in couplets 11 and 12, transpose '12' and '13'.

Page 221; couplet 28 first line, for 'male' read female.

Page 203. The genus *Dasyllis*, according to Col. Yerbury, comprises but a single species, the type; the American species should be united with *Laphria*. In this opinion I agree. According to the same authority *Nusa* is not a synonym for *Andrenosoma*, which should be substituted for that word in the eleventh line.

Page 206. Mr. Verrall has resuscitated *Dialineura* Rond. for those species of *Thereva* having a hairy front, the face bare and the first antennal joint thickened. This definition will apply to some, probably to all of those species included under **'Thereva**, pt.' in couplet 3 and should be substituted therefor.

Page 217. The type specimen of *Rhabdopselaphus mus* Bigot, one of the three or four genera of this family I had never seen, in Mr. Verrall's collection, lacks the head; otherwise it is a true *Geron*. Bigot erred in ascribing three submarginal cells to the genus.

P. 256, couplet 53, for '**Licastrirhyncha**' read **Lycastrirhyncha**

Page 269, sixth line from bottom, for 'irridescent wing' read iridescent wings.

Page 277, couplet 3, first line, for '5' read 4; **Callopistromyia** Hendel (1907) replaces **Callopistria**, preoc. **Eurycephalomyia** Hendel (ibid) replaces **Eurycephala**, preoc.

Page 279, first line, for **'Richarulia'** read **Richardia; Macrostenomyia** Hendel (1907) replaces **Stenomacra**, preoc.

Page 283, first couplet, for 'slump' read stump, and **'Toxytrypana'** read **Toxotrypana.**

Page 288. Hendel (Wien. ent. Zeit., 1907, 228) adopts *Chætocælia* G. T. for several species of *Sapromyza*, of which *S. angustipennis* (5) is one, having long, pictured wings and small tubercles at the insertion of the fronto-orbital bristles. *Camptoprosopella melanoptera*, gen. et sp. nov. (Puebla, Mex.) he distinguishes from *Physogenua* by the nongibbous face, which is straight and retreating save at oral margin,

bare arista, etc. *Siphonophysa* he proposes for a new species (*pectinata*, Brazil) and probably *S. sordida* Wied. (Brazil and West Indies) having the arista plumose above only and a 'hinten ausgeschweiften Augenrand'). *Chætocœlia* may be accepted, but the other two genera I think should be held in abeyance for the present. If they are accepted a dozen or more of the American species of *Sapromyza* and *Pachycerina* should receive new names.

Mr. Hendel republishes the earliest paper of Meigen, of which two copies only are known to be in existence, in which scores of names, many of them repudiated later by Meigen, antedate some of the most common genera in diptera, and advises their substitution! He would have deserved the thanks of a long suffering public had he withheld these copies instead of republishing.

Page 294, couplet 3, third line add: or the proboscis not long and geniculate. *Phyllomyza nitens* Loew is a *Paramyia*.

Page 295. Mr. Becker, recently, makes *Ophthalmomyia* a synonym of *Milichiella* G. T. (1895); he is correct.

Page 298. Geomyzidæ. **Pseudiastata** Coq. (Proc. Ent. Soc. Wash. 1908), near *Diastata*, but second basal cell coalescent with discal; three fronto-orbitals; vibrissæ present.—*nebulosa* Coq. Md. **Mutiloptera** Coq. (ibid.); wings six times longer than wide; arista short plumose; one fronto-orbital; no postverticals; vibrissæ present; hind border of wing concave,—*apicalis* Coq. N. Dak.

Page 299, second line from bottom, for 'posterior' read basal.

Page 301, couplet 2, dele 'p. 80,12 and'.

Page 303, eighteenth line, for 'and small' read or absent.

Page 308, couplet 22, for 'sixth' read fifth.

Page 325, Helomyzidæ. A very useful review of the North American Helomyzidæ, recently published by Aldrich and Darlington (Trans: Amer. Ent. Soc. xxiv, March, 1908) adds two new genera to our fauna. These, together with one recently described by Coquillett (Can. Entom. March, 1907) may be differentiated from those given in the table as follows:

Near *Helomyza*, a propleural, two dorsocentral, two fronto-orbitals, one sternopleural bristles present (*pilosus*, Mass.) **Achætomus** Coq.

Humeral, propleural, one dorsocentral, one fronto-orbital, no sternopleural bristles present; oral margin receding, as in *Anorostoma*. (*johnsoni*, Mass.) . . . . . **Porsenus** Darl.

A humeral, propleural, five dorsocentral, two fronto-orbital, two sternopleural bristles present; auxiliary vein indistinct. (*oregona*, *litorea*, Oregon, Calif.) . . . . . **Siligo** Aldr.

The authors reject *Heteromyza* as of doubtful occurrence in North America, leaving all the American forms easily recognized by the pectinate costa. They also merge *Scoliocentra* into *Leria*,—which I doubt.

Page 329, couplet 6, second line for 'pleural' read central.

Page 334, couplet 73, for 'cell' read vein.

Page 376, couplet 164, for '169' read 165.

Mr. Townsend proposes to make the specimen illustrated in Fig. 156 the type of a new genus and species, which he will call *Euepalpus flavicauda*. For Fig. 157, he also proposes the new genus and species *Eufabricia flavicans* Towns.

INDEX.

A

Ablabesmyia, 114
Ablautus, 197
Acanthina, 171
Acanthinomyia, 388
Acanthocnema, 330
Acanthomera, 174
ACANTHOMERIDÆ, 173
Acaulona, 361
Acemyia, 374
Achalcus, 234
Achætomus, 390
Achætoneura, 380
Acicephala, 330
Acidia, 286
Acidogona, 287
Aciura, 286
Acnemia, 137
Acontistoptera, 239
Acorhynchus, 127
Acreotrichus, 216
ACROCERIDÆ, 182
Acrochæta, 169
Acrocera, 185
Acrodiplosis, 128
Acrometopia, 296
Acronacantha, 356
Acrosticta, 278
Acrotænia, 287
Actina, 168
Actora, 323
Admontia, 363
Aedes, 108
Aedomyia, 107
Aenigmatias, 239
Agathomyia, 243
Agonosoma, 232
Agromyza, 295
AGROMYZIDÆ, 291
Akronia (*Alisonia*), 171
Alasion, 116
Aldrichia, 214
Allognosta, 168
Allograpta, 255
Allopogon, 201
Allophyla, 325
Allotrichoma, 307
Alophora 361, 378
Amalopis, 90
Amobia, 377
Amphicnephes, 275
Amphicosmus, 216
Anacampta, 276
Anaclinia, 138
Analcocerus, 170
Anarmostus, 204
Anastœchus, 215
Anastrepha, 283
Anatopynia, 113
Andrenosoma, 389
Anepsius, 233
Anisia, 367, 379
Anisomera, 90
Anisotamia, 215
Anopheles, 107
Anorostoma, 325
Anthalia, 225
Anthepiscopus, 225
Anthomyia, 335
ANTHOMYIDÆ, 331
Anthrax, 214
Antocha, 88
Aochletus, 171
Apalocnemis, 226
Apatolestes, 180
Aphestia, 202
Aphiochæta, 238
Aphœbantus, 217
Aphrosylus, 233
Aphria, 372
Apinops, 365
Apiocera, 189
APIOCERIDÆ, 188
Apocephalus, 238
Apomidas, 188
Apophorhynchus, 281
Aporia, 379
Appeleia, 185
Aprionus, 130
Aptilotus, 316
Araba, 375

Archilestris, 198
Archytas, 577
Arctobiella, 296
Arctophila, 257
Argyra, 234
Arnoldia, 128
Arribalzagia, 188
Arthroceras, 162
Arthrocnodax, 128
Arthropeas, 162
Asemosyrphus, 258
Asilus, 203
ASILIDÆ, 192
Asindulum, 137
Asphondylia, 126
Aspistes, 144
Asteia, 302, 312
Astrophanes, 214
Asynapta, 129
Asyndetus, 233
Atacta, 372
Atarba, 88
Ateloglossa, 355
Atherix, 163
Athyroglossa, 307
Atomosia, 202
Atonia, 202
Atractia, 203
Atrichopogon, 116
Atropharista, 380
Atrophopalpus, 363
Atylotus, 181
Aulacigaster, 295
Automola, 276
Azelia, 336

B

Baccha, 254
Baldratia, 127
Balioptera, 298
Baryphlegma, 287
Bathydexia, 354
Baumhaueria, 372
Belvosia, 372
Beris, 168
Berismyia, 168
Beskia, 371
Besseria, 377
Bezzia, 116
Bibio, 143
Bibiocephala, 151
Bibiodes, 143
BIBIONIDÆ, 140
Bicellaria, 225
Biomyia, 373
Bischofia, 323
Bittacomorpha, 91
Blastocera, 172
Blepharepium, 201
Blepharipeza, 374
Blepharocera, 151
BLEPHAROCERIDÆ, 148
Blepharoneura, 287
Blepharoprocta, 224
Bogeria, 347
Bolbomyia, 163
Boletina, 138
Bolitophila, 136
Bolomyia, 373
BOMBYLIIDÆ, 210
Bombyliomyia, 377
Bombylius, 215
BORBORIDÆ, 315
Borborus, 316
Boreodromia, 223
Brachycampta, 139
Brachycoma, 375
Brachydeutera, 309
Brachyneura, 130
Brachyopa, 256
Brachyophyra, 334
Brachypalpus, 259
Brachypremna, 91
Brachystoma, 224
Brachypteromyia, 383
Bremia, 128
Bricinnia, 275
Briciniella, 275
Bryocrypta, 129
Bryomyia, 130
Bucentes, 371

C

Cacodæmon, 199
Cacomyia, 109
Cacosis, 171
Cacoxenus, 296
Cænia, 309
Callicera, 252
Callimyia, 243
Callinicus, 201
Calliphora, 343
Callopistria, 277
Calobata, 266

Calodexia, 357
Calotarsa, 243
Camarona, 355
Campeprosopa, 170
Campsicnemus, 235
Camptocladius, 115
Camptomyia, 129
Camptoneura, 276
Campylomyza, 127, 130
Canace, 306
Caricea, 336
Cardiacephala, 266
Carphotricha, 287
Catocha, 127
Cecidomyia, 126
CECIDOMYIDÆ, 117
Celatoria, 369
Cellia, 108
Ceratitis, 283
Ceratobarys, 312
Ceratocystia, 109
Ceratogopsis, 199
Ceratolophus, 116
Ceratomyiella, 363
Ceratomyza, 295
Ceratopogon, 115
Ceraturgus, 199
Ceria, 252
Ceriogaster, 257
Ceroplatus, 137
Cerotainia, 202
Cerozodia, 81
Cephalia, 275
Cephenomyia, 347
Cestonia, 377
Chætoclusia, 320
Chætogædia, 376
Chætogena; 377
Chætoglossa, 372
Chætona, 330, 356
Chætophleps, 365
Chætoplagia, 375
Chætopsis, 278
Chalarus, 245
Chalcomyia, 253
Chamæsyrphus, 255
Charadrella 336
Chasmatonotus, 114
Chelipoda, 223
Chersodromia, 223
Chilosia, 253
Chionea, 86
Chiromyza, 168
Chironomus, 115
CHIRONOMIDÆ, 110
Chloroprocta, 342
Chlorops, 313
Cholomyia, 356
Chordonota, 170
Chorisops, 388
Choristoma, 236
Choristoneura, 127
Chortophila, 336
Chrysoceria, 201
Chrysochlamys, 259
Chrysochlora, 171
Chrysochroma, 169
Chrysogaster, 233
Chrysomyia, 342
Chrysomyza, 278
Chrysopila, 163
Chrysops, 180
Chrysotimus, 234
Chrysotoxum, 252, 257
Chrysotus, 235
Chyliza, 268
Cistogaster, 361
Cladochæta, 302
Cladodromia, 223
Cladura, 88
Clausicella, 365
Clinocera, 224
Clinodiplosis, 129
Clinogaster, 372
Clinoneura, 357
Clinopea, 343
Clinorhyncha, 126
Clinorhytis, 129
Clista, 367
Clitellaria, 171
Clytiomyia, 371
Clusia, 320
Clusiodes, 320
Cnephalia, 378
Cœloglutus, 233
Cœlometopia, 279
Cœlomyia, 336
Cœlopa, 317
Cœnomyia, 162
Cœnosia, 336
Coloboneura, 223
Colomyia, 129
Colpodia, 126
Comoptera, 238

Comotacta, 374
Comyops, 357
Conchyliastes, 159
Condidea, 257
Coniceps, 279
Conicera, 238
CONOPIDÆ, 261
Conops, 263
Contarina, 129
Copestylum, 256
Cophura, 201
Coquillettia, 214
Coquillettidea, 109
Cordyligaster, 356
Cordylura, 330
CORDYLURIDÆ, 327
Corethra, 107
Corethrella, 107
Corynoneura, 114
Cricotopus, 115
Crioprora, 259
Criorhina, 259
Cryptochætum, 295
Cryptolabis, 88
Cryptomeigenia, 363
Cryptopalpus, 377
Ctenophora, 91
Culex, 108
Culicelsa, 109
Culicada, 109
Culicella, 109
CULICIDÆ, 86
Culicoides, 116
Culiseta, 108
Cuphocera, 377
Curtonotum, 302
Cuterebra, 347
Cycloleppteron, 108
Cylindrotoma, 90
Cynipimorpha, 172
Cynomyia, 342, 350
Cyphomyia, 170
CYRTIDÆ, 182
Cyrtometopia, 279
Cyrtoneurina, 343
Cyrtophlebia, 372
Cyrtopogon, 200
Cyrtosoma, 357
Cystiphora, 128

D

Dactylocladius, 115
Dæochæta, 377
Dalmannia, 263
Damalis, 198
Dasylechia, 203
Dasyllis, 203
Dasyneura, 128
Dejeania, 377
Deinocerites, 107
Demoticus, 375
Dermatobia, 347
Deromyia, 201
Desmatomyia, 217
Desmatoneura, 217
Desmometopa, 295
Dexia, 355
DEXIIDÆ, 352
Dexiopsis, 336
Dexiosoma, 357
Diachlorus, 181
Diacrita, 276
Diadocidia, 136
Diallactes, 129
Dialineura, 387
Dialysis, 163
Diamesa, 114
Diaphoropeza, 379
Diaphorus, 235
Dicranomyia, 87
Dicolonus, 200
Dichæta, 307
Dichelacera, 181
Dichocera, 376
Diclisa, 180
Dicranophora, 169
Dicranoptycha, 88
Dicranota, 90
Dicrodiplosis, 128
Dictanus, 197
Didyma, 367
Dilophus, 143
Dioctria, 200
Dionæa, 369
Diostracus, 234
DIOPSIDÆ, 314
Diotrepha, 88
Dipalta, 214
Diplosis, 126
Dirhiza, 126
Discobola, 87
Discocerina, 307
Discomyza, 307
Ditomyia, 137

Dixa, 95
DIXIDÆ, 94
Dizonias, 199
Docosia, 138
Dolicocephala, 224
Dolichogaster, 191
Dolichoglossa, 335
Dolichomyia, 217
Dolichopeza, 91
DOLICHOPODIDÆ, 228
Dolichopus, 232
Doliosyrphus, 256
Doryclus, 202
Drapetis, 223
Drepanoglossa, 380
Drosophila, 302
DROSOPHILIDÆ, 299
Dryomyia, 128
Dryomyza, 323
Dynatosoma, 137

E

Eccoptomera, 326
Eccritosia, 203
Ecculex, 109
Echinodexia, 357
Echthodopa, 200
Echinomyia, 377
Ecitomyia, 238
Eclimus, 216
Ectecephala, 312
Ectyphus, 191
Elachipalpus, 376
Elachiptera, 312
Elephantomyia, 87
Elliponeura, 312
Elliptera, 88
Eliozeta, 377
Empeda, 819
EMPIDIDÆ, 218
Empimorpha, 226
Empis, 226
Endaphis, 128
Ensina, 287
Epacmus, 217
Epalpus, 377
Ephydra, 309
EPHYDRIDÆ, 303
Epicypta, 138
Epidapus, 139
Epidosis, 126
Epigrimyia, 371
Epiphragma, 89
Epiplatea, 279
Epochroa, 286
Erax, 203
Eremomyia, 335
Eretmoptera, 113
Eriocera, 90
Erioptera, 88
Eristalis, 256
Ervia, 365
Erythrandra, 350
Euantha, 356
Euaresta, 287
Eucessia, 217
Euchætogyne, 357
Euclytia, 380
Eucnephalia, 377
Eudexia, 357
Eudicrana, 137
Eugnoriste, 139
Eujurinia, 380
Eulasiona, 363
Eulonchus, 185
Eumetopia, 278
Euparhyphus, 171
Eupeodes, 255
Euphara, 278
Euphantopteryx, 379
Euphorocera, 374
Eurina, 313
Eurosta, 287
Eurycephala, 277
Euryceromyia, 365
Eurycnemus, 115
Euryneura, 171
Euryomyia, 336
Euscopolia, 371
Eusiphona, 295
Eustalomyia, 335
Eutanypus, 114
Eutarsus, 235
Euthera, 374
Euthyneura, 225
Euthyprosopa, 375
Eutreta, 287
Eutrixa, 369
Euxesta, 278
Evibrissa, 377
Exechia, 139
Exepacmus, 216
Exorista, 374
Exoristoides, 373
Exoprosopa, 214

F

Feltidia, 109
Ferdinandea, 259
Firenia, 130
Forcipomyia, 116
Frontina, 374
Fucellia, 336

G

Gastrophilus, 346
Gædiophana, 377
Gædiopsis, 376
Gastrops, 308
Gaurax, 312
Geminaria, 216
GEOMYZIDÆ, 297
Geosargus, 169
Geranomyia, 87
Geron, 217
Ginglimyia, 371
Glaurotricha, 257
Glutops, 162
Gnophomyia, 89
Gnorista, 137
Gonia, 376
Goniochæta, 371
Goniops, 180
Gonomyia, 89
Graphomyia, 343
Griphoneura, 290
Gymnochæta, 373
Gymnoclytia, 378
Gymnodexia, 355
Gymnometopa, 109
Gymnomma, 376
Gymnophania, 361
Gymnophora, 238
Gymnopternus, 233
Gymnosoma, 361

H

Habropogon, 200
Hadromyia, 259
Hæmagogus, 108
Hæmatobia, 342
Hæmatopota, 180
Hammerschmidtia, 256
Hammomyia, 336
Haplomera, 226
Harmandia, 129
Heleodromia, 224
Helicobia, 351
Heligmoneura, 204
Helobia, 89
Helomyza, 325
Helophilus, 258
Hemerodromia, 223
Hemeromyia, 295
Hemichlora, 342
Hemithrixion, 377
HELOMYZIDÆ, 324
Hemyda, 363
Henicomyia, 207
Hercostomus, 233
Hermetia, 171
Hesperempis, 226
Hesperinus, 143
Hesperodes, 143
Hesperomyia, 350
Heteracantha, 168
Heteringomyia, 320
Heterocheila, 323
Heterochroa, 298
Heteromyia, 116
Heteromyza, 326
Heteroneura, 320
HETERONEURIDÆ, 318
Heteropeza, 126, 130
Heteropogon, 201
Heteropterina, 371
Heterostylum, 215
Hexachæta, 283
Hexamitocera, 330
Hiatus, 276
Hilara, 226
Hilarella, 376
Hilarempis, 226
Hilarimorpha, 157, 163, 218
Himantostoma, 377
Himeroëssa, 275
Hippelates, 312
HIPPOBOSCIDÆ, 382
Hirmoneura, 187
Histiodroma, 169
Holcocephala, 200
Holoneurus, 129
Holopogon, 200
Holorusia, 91
Homalomyia, 334
Homodexia, 357
Homogenia, 361
Hoplogaster, 336
Hormomyia, 126
Hormopeza, 224

Houghia, 374
Hyadesimyia, 343
Hyadina, 308
Hyalomyodes, 369
Hyalurgus, 367
Hybos, 224
Hydrellia, 308
Hydrina, 308
Hydromyza, 330
Hydrophoria, 334
Hydrophorus, 234
Hydrotæa, 334
Hyetodesia, 334
Hylemyia, 335
Hypantrophaga, 374
Hyperalonia, 214
Hypertophorocera, 377
Hypocera, 238
Hypochæta, 365
Hypocharassus, 234
Hypoderma, 347
Hypostena, 367
Hystricia, 377
Hystrisiphona, 354

I

Icterica, 287
Idana, 276
Idioplasta, 99
Ilythea, 307
Isoglossa, 371
Isoplastus, 114
Isostomyia, 109
Iteaphila, 226

J

Janetiella, 128
Janthinosoma, 109
Joannisia, 130
Joblotia, 108
Johannseniella, 116
Johnsonia, 350
Jurinella, 377
Jurinia, 377

L

Lamprempis, 225
Lampria, 203
Laphria, 203
Laphystia, 199
Lasia, 185
Lasiona, 363
Lasioneura, 365
Lasiopogon, 200
Lasiops, 335
Lasioptera, 126
Lasiopteryx, 127
Lasiosoma, 136
Lastaurus, 201
Lauxania, 290
Leia, 137
Ledomyia, 130
Lepidanthrax, 215
Lepidophora, 216
Lepidoplatys, 109
Lepidoselaga, 181
Lepidostola, 252
Lepromyia, 252
LEPTIDÆ, 157
Leptis, 163
Leptocorypha, 232
Leptoda, 356
Leptogaster, 197
Leptomorphus, 138
Leptomydas, 191
Leptopeza, 225
Leptopteromyia, 195
Leria, 326
Leskiamima, 365
Lestiocampa, 108
Lestodiplosis, 129
Lestomyia, 201
Lestremia, 127
Leptorethum, 232
Leptosyna, 130
Leucomelina, 334
Leucophenga, 302
Leucopis, 296
Leucostola, 235
Leucostoma, 369
Leucozona, 255
Limatus, 108
Liancalus, 234
Limnobia, 87
Limnophila, 89
Limnophora, 334
Limnospila, 336
Limosina, 316
Liogma, 90
Lipochæta, 306
Lipoptena, 383
Linnæmyia, 373
Lispa, 336
Lispidia, 365

Lœwiola, 129
Lonchæa, 290
Lonchoptera, 240
LONCHOPTERIDÆ, 240
Longurio, 91
Lophoteles, 172
Lordotus, 216
Loxocera, 268
Lycastrirhyncha, 266
Lyperosa, 342
Lytogaster, 308
Lucilia, 343
Lutzia, 108

M

Machimus, 204
Macquartia, 367
Macrocera, 136
Macrodiplosis, 129
Macrolabis, 127
Macromeigenia, 373
Macrometopa, 256
Macrosargus, 169
Mallophora, 203
Mallota, 258
Mancia, 214
Manota, 135
Mansonia, 107
Masicera, 375
Masistylum, 377
Massalongia, 128
Mauromyia, 363
Maytiola, 128
Medeterus, 213
Medina, 365
Megamerina, 268
Megametapon, 256
Megaparia, 355
Megapoda, 202
Megaprosopus, 355
Megarhinus, 107
Megerlea, 355
Meghyperus, 224
Megistocera, 91
Megistopoda,
Megophthalma, 330
Meigenia, 363
Meigeniella, 363
Melaleuca, 356
Melanodexia, 355
Melanophora, 355
Melanophyra, 373
Melanostoma, 254
Melieria, 276
Melophagus,
Merapioidus, 259
Meriana, 377
Merodon, 258
Meromacrus, 256
Meromyza, 313
Merosargus, 169
Mesembrina, 243
Mesembrinella, 342
Mesochæta, 367
Mesorhaga, 232
Mesogramma, 255
Metacosmus, 217
Metachæta, 375
Metachela, 223
Metadexia, 356
Metadoris, 377
Metaphragma, 207
Metaphyto, 374
Metaplagia, 372
Metapogon, 200, 201
Metatrichia, 209
Metopia, 376
Metopina, 238
Metriocnemus, 115
Miaster, 126
Alicræ, 109
Michrochætina, 355
Microchrysa, 169
Microdon, 252
Microdira, 377
Microdromia, 223
Micromyia, 127, 130
Micropeza, 266
MICROPEZIDÆ, 264
Microphorus, 225
Microphthalmia,
Microprosopa, 330
Microsmia, 225
Microstylum, 198
Mikiola, 128
Milesia, 256
Milichia, 295
Milichiella, 295
Miltogramma, 375
Misgomyia, 387
Mixogaster, 252
Mochlonyx, 107
Mochlosoma, 354
Mochlostyrax, 109

Monardia, 130
Monarthropalpus, 128
Mongoma, 89
Molophilis, 88
Molynocœlia, 286
Morellia, 343
Morinia, 357
Morphomyia, 356
Mosillus, 307
Musca, 343
MUSCIDÆ, 337
Muscina, 343
Muscopteryx, 375
Mutiloptera, 387
Mycetobia, 136
Mycetaulus, 270
Mycetophila, 137
MYCETOPHILIDÆ, 131
Mycodiplosis, 128
Mycothera, 139
Myelaphus, 199
Myennis, 277
Mydæa, 334
MYDAIDÆ, 190
Mydas, 191
Myocera, 354
Myiochrysa, 169
Myolepta, 253
Myomima, 354
Myospila, 343
Myothiria, 369
Myopharus, 369
Myophasia, 363
Myoscotiptera, 354
Myopa, 263
Myrmecomyia, 275
Mystacella, 377
Mystacomyia, 373
Mythicomyia, 218
Myxosargus, 170
Myzomyia, 108

N

Næria, 365
Napomyza, 294
Nausigaster, 253
Nebritus, 207
Nematoproctus, 234
Nemopoda, 270
Nemoræa, 373
NEMESTRINIDÆ, 186
Neoascia, 254
Neoaspilota, 287
Neochauna, 172
Neocota, 225
Neoculex, 109
Neoempheria, 136
Neoexaireta, 168
Neofischeria, 380
Neoglaphyroptera, 137
Neodiotypa, 179
Neoitamus, 204
Neophyto, 379
Neoplasta, 223
Neoroudania, 170
Neotractocera, 377
Nephrocerus, 245
Nerius, 266
Neurigona, 234
Neuroctona, 323
Nicocles, 201
Nostima, 308
Nothra, 185
Nothomyia, 169
Nothosympycnus, 235
Notiphila, 307
Notogramma, 278
Nototricha, 108
Nusa, 203
Nycteribia, 386
NYCTERIBIIDÆ, 386

O

Occemyia, 263
Ochthera, 308
Ochtheroidea, 308
Ochthiphila, 296
Ocnæa, 185
Ocydromia, 225
Ocyptamus, 254
Ocyptera, 372
Octodiplosis, 128
Odinia, 296
Odontomyia, 170
Odontonyx, 139
Odontopoda, 138
Œcacta, 116
Œcothea, 326
Œdalia, 224
Œdamagena, 347
Œdaspis, 286
Œdicarena, 286
Œdimapeza, 379
Œdopa, 277
Œstrophasia, 369

Œstrus, 347
Olbiogaster, 156
Olfersia.
Oligarces, 130
Oligotrophus, 128
Ommatius, 203
Omomyia, 317
Oncodes, 185
Oncodocera, 216
Onesia, 350
Ophthalmomyia, 295, 390
Opsebius, 185
Odsidia, 376
Opsiomyia, 330
Oreogeton, 225
Oreothalia, 224
Orimarga, 88
Ornithoctena, 383
Ornithodes, 90
Ornithoica, 383
Ornithomyia, 383
Ornithopertha, 383
Orphnephila, 154
ORPHNEPHILIDÆ, 153
ORTALIDIDÆ, 271
Orthochæta, 330
Orthocladius, 115
OSCINIDÆ, 310
Oscinia, 312
Osspriocerus, 198
Ostracocœlia, 275
Oxycera, 171
Ozodiceromyia, 207

P

Pachycerina, 290
Pachygaster, 172
Pachymeria, 226
Pachyophthalmus, 372
Palloptera; 290
Pachyrhina, 91
Palpomyia, 116
Paltostoma, 151
Panacris, 172
Paneryma, 279
Pangonia, 180
Pantarbes, 215
Pantophthalmus, 175
Panzeria, 373
Parabombylius, 215
Parachæta. 374
Paraclius, 233
Paracosmus, 217
Paradejeania, 377
Paradidyma, 375
Parodinia, 296
Paradyschiria,
Paradmontia, 363
Parafischeria, 380
Paragædia, 377
Paragus, 252
Paragorgopis, 277
Parahypochæta, 377
Paralimna, 308
Paralleloma, 329
Paramesochæta, 373
Paramintho, 350
Paramyia, 294
Paranophora, 379
Paraphyto, 374
Paraplagia, 372
Paraprosena, 357
Paratissa, 367
Parasyntormon, 235
Parathalassina, 224
Paratropesa, 819
Parephydra, 307
Parepalpus, 376
Parexorista, 379
Parydra, 309
Parœdopa, 277
Peckia, 350
Pedicella, 172
Pedicia, 90
Pegomyia, 335
Pelagomyia, 171
Pelastoneurus, 232
Pelatachina, 367
Pelateria. 377
Pelecocera, 252
Pelina, 308
Pelomyia, 295, 307
Pelorempis, 107
Peloropeodes, 233
Pentacricea. 336
Penthoptera, 90
Penthosia, 373
Peratochætus, 298, 330
Pericoma, 93
Pero, 130
Peromyia, 130
Peronyma, 286
Perrisia, 127
Peteina, 377
Phalacrocera, 90

Phalacromyia, 257
Phaonia, 334
Phasioclysta, 379
Phasiops, 356
Pheneus, 163
Phlebotomus, 93
Philonicus, 204
Philopota, 185
Philorus, 151
Phoneutisca, 223
Phoniomyia, 108
Phora, 238
Phorantha, 361
Phorbia, 336
Phoriclæta, 375
PHORIDÆ, 236
Phormia, 343
Phorocera, 374
Phorostoma, 355
Phortica, 301
Phronia, 138
Phthinia, 138
Phthiria, 216
PHYCODROMIDÆ, 317
Phylarchus, 234
Phyllogaster, 336
Phyllolabis, 89
Phyllomyza, 296
Phylomidas, 191
Phylygra, 308
Phyra, 334
Physocephala, 263
Physogenua, 290
Phyto, 363
Phytomyza, 294
Pialeoidea, 185
Piophila, 270
PIOPHILIDÆ, 269
Pipiza, 252
PIPUNCULIDÆ, 244
Pipunculus, 245
Pityocera, 180
Plagia, 371
Plagiomima, 371
Plagioneura, 232
Plagiotoma, 286
Plagiprospherysa, 372
Plastophora, 238
Platophrymyia, 295
Platychirus, 254
Platycnema, 243
Platymochætus, 257
Platypalpus, 222
Platypeza, 245
PLATYPEZIDÆ, 241
Platystoma, 275
Platyura, 137
Plecia, 142
Plectops, 365
Plectromyia, 90
Plesiastina, 137
Plesiomma, 200
Plethochæta, 330
Ploas, 216
Pneumaculex, 108
Pocota, 259
Pogonomyia, 334
Pogonosoma, 202
Pogonota, 330
Polidea, 367
Polinota, 283
Pollenia, 342
Porphyrops, 235
Porsenus, 390
Polyangæus, 90
Polydontomyia, 258
Polygaster, 367
Polylepta, 136
Polymedon, 233
Polymera, 88
Polymorphomyia, 286
Polystepha, 128
Priomerus, 256
Prionellus, 130
Probezzia, 116
Probolæus, 135
Procladius, 113
Prochyliza, 270
Proctacanthus, 203
Prodiamesa, 114
Prolepsis, 199
Promachus, 203
Promeranisa, 170
Prorates, 224
Prorhynchops, 354
Prosalpia, 336
Prosena, 354
Prosenoides, 354
Prospherysa, 375
Protanypus, 113
Protenthes, 387
Protocalliphora, 343
Protoculex, 109
Psairoptera, 277

Psectrocladius, 115
Pselaphila, 329
Pseudapinops, 365
Pseudiastata, 390
Pseudochæta, 374
Pseudoculex, 109
Pseudodexia, 357
Pseudodinia, 296
Pseudolfersia, 383
Pseudomorina, 357
Pseudopyrellia, 343
Pseudorus, 202
Pseudotephritis, 277
Pseudotrichia, 209
Pseudotractocera, 373
Psila, 268
PSILIDÆ, 267
Psilocephala, 207
Psilocurus, 199
Psilopa, 307
Psilopodinus, 222
Psilopus, 232
Psilotanypus, 113
Psilota, 253
Psorophora, 108
Psychoda, 93
PSYCHODIDÆ, 92
Ptecticus, 169
Pterallastes, 257
Pterellipsis, 385
Pterocella, 277
Pterodontia, 185
Ptilodexia, 356
Ptilodegeeria, 367
Ptilomyia, 307
Ptiolina, 163
Ptychoptera, 91
Puliciphora, 238
Putoniella, 128
Pycnoglossa, 330
Pycnopogon, 200
Pyrellia, 343
Pyrgota, 274
Pyritis, 357
Pyrophæna, 253

R

Racodineura, 368
Rhabdopselaphus, 217
Rhachicerus, 162
Rhadiurgus, 204
Rhagoletis, 286
Rhamphidia, 87
Rhamphinina, 357
Rhamphomyia, 225
Rhaphiocera, 169
Rhaphidolabis, 90
Rhaphiomidas, 188
Rhaphirhynchus, 174
Rhaphium, 235
Rhombothyria, 357
Rhopalomera, 281
RHOPALOMERIDÆ, 280
Rhopalomyia, 128
Rhopalosyrphus, 252
Rhicnoëssa, 296
Rhingia, 256
Rhingiopsis, 179
Rhinophora, 363, 379
Rhinotora, 281
Rhipidia, 87
Rhymosia, 139
Rhynchocephalus, 186
Rhynchodexia, 354
Rhynchosciara, 139
RHYPHIDÆ, 155
Rhyphus, 155
Rhypholophus, 88
Rhysops, 253
Richardia, 279
Rileymyia, 378
Rivellia, 275
Rœderiodes, 223
Ruebsaamenia, 129
Runchomyia, 108

S

Sabethes, 108
Salpingogaster, 254
Sapromyza, 290
SAPROMYZIDÆ, 288
Sarcionus, 232
Sarcoclista, 363
Sarcomacronychia, 380
Sarcophaga, 351
SARCOPHAGIDÆ, 348
Sarcophagula, 351
Sarcophilodes, 350
Sardiocera, 356
Sargus, 169
Saropogon, 201
Sayomyia, 107
Scæva, 255
Scatella, 309

Scatomyzidæ, 327
Scatophaga, 329
Scatophagidæ, 327
Scatopse, 143
Scellus, 234
Scenopinidæ, 208
Scenopinus, 209
Schizomyza, 128
Schizotachina, 375
Schœnomyza, 336
Sciara, 139
Sciasma, 369
Sciomyza, 323
Sciomyzidæ, 321
Scione, 180
Sciophila, 136
Scleropogon, 198
Scoliocentra, 325
Scoliopelta, 171
Scotiptera, 354
Senobasis, 201
Senogaster, 258
Senoprosopis, 204
Senotainia, 373
Seoptera, 278
Sepedon, 323
Sericomyia, 257
Serromyia, 116
Sepsidæ, 269
Sepsis, 270
Sepsisoma, 278
Sicus, 263
Sigaloessa, 302, 312
Sigmatomera, 88
Siligo, 390
Silvius, 180
Simuliidæ, 144
Simulium, 147
Siphona, 371
Siphonella, 312
Siphoplagia, 371
Siphosturmia, 373
Snowiellus, 181
Somomyia, 343
Spallanzania, 376
Spania, 163
Spaniocera, 125
Sparnopolius, 216
Spathiophora, 330
Sphærina, 367
Sphærocera, 316
Sphæromyas, 116
Sphærophoria, 255
Sphageus, 198
Sphecomyia, 259
Sphegina, 254
Sphenoidoptera, 216
Sphyracephala, 314
Sphyximorpha, 252
Spilochroa, 298, 320
Spilogaster, 334
Spilographa, 286
Spilomyia, 259
Spogostylum, 214
Spyridopa, 172
Stegana, 301
Stegomyia, 108
Steneretma, 279
Stenodexia, 356
Stenodiplosis, 129
Stenomacra, 279
Stenomicra, 302
Stenomyia, 278
Stenopa, 286
Stenopogon, 188
Stenopterina, 275
Stenoxenus, 113
Stevenia, 377
Stibasoma, 181
Stichopogon, 200
Stictomyia, 277
Stilbometopa,
Stilpnogaster, 204
Stilpon, 223
Stomoxys, 342
Stratiomyia, 170
Stratiomyidæ, 164
Straussia, 286
Strebla, 385
Strebl1dæ, 384
Stomatodexia, 355, 380
Strobliella, 127
Stygeropis, 91
Stylogaster, 263
Sycorax, 93
Symballophthalmus, 222
Symphoromyia, 163
Sympycnus, 235
Syndyas, 224
Syneches, 224
Syneura, 238
Synthesiomyia, 342
Syntemna, 138
Syntormon, 236

Syritta, 255
SYRPHIDÆ, 246
Syrphus, 255
Systœchus, 215
Systropus, 217

T

Tabanus, 181
TABANIDÆ, 176
Tabuda, 207
Tachina, 375
TACHINIDÆ, 358
Tachinomyia, 378
Tachinopsis, 375
Tachydromia, 223
Tachypeza, 222
Tachytrechus, 233
Tæniorhynchus, 108
TANYPEZIDÆ, 264
Tanypremna, 91
Tanypus, 114
Tanytarsus, 115
Taracticus, 201
Tauromyia, 298
Telmatogeton, 114
Telostylus, 266
Telothyria, 371
Temnostoma, 259
Tephritis, 287
Tephrochlamys, 325
Tephronota, 276
Tersesthes, 115
Tetanocera, 323
Tetanops, 276
Tetrachæta, 336
Tetragoneura, 136
Tetragrapha, 377
Tetropismenus, 276
Teuchocnemis, 258
Teucholabis, 88
Teuchophorus, 235
Toreus, 226
Townsendia, 198
Toxomerus, 255
Toxorhina, 87
Toxophora, 217
Toxotrypana, 283
Thalassomyia, 114
Thecodiplosis, 129
Thecomyia, 323
Thelaira, 357
Thelairodes, 356
Themira, 270
Theresia, 357
Thereva, 207
THEREVIDÆ, 205
Theria, 351
Therioplectes, 181
Thinodromia, 223
Thinophilus, 235
Thrypticus, 233
Thryptocera, 365
Thysanomyia, 375
Tinolestes, 109
Tipula, 91
TIPULIDÆ, 81
Traginops, 296
Trichina, 225
Trichobius, 385
Trichocera, 89
Trichocladius, 115
Trichogena, 376
Trichomyia, 93
Trichonta, 138
Tricophora, 377
Trichophthicus, 334
Trichopoda, 361
Trichopteromyia, 127
Trichosia, 139
Trichotanypus, 114
Triclis, 199
Tricolyga, 377
Tricopalpus, 330
Trigonometopus, 323, 321
Trimicra, 89
Trineura, 238
Triodonta, 258
Triogma, 90
Triptotricha, 163
Tritoxa, 276
Tritozyga, 127
Trixa, 363
Trixodes, 355
Trochilides, 375
Tromodexia, 355
Tropidia, 257
Tropidomyia, 262
Tropidopsis, 377
Trypeta, 286
TRYPETIDÆ, 282
Triplasius, 215
Tylomyia, 270
Tyreomma, 342

U

Ula, 90
Ulidia, 278
Ulomorpha, 89
Uramyia, 356
Uranotænia, 107
Urellia, 287

V

Vanderwulpia, 369, 374
Verrallia, 245
Volucella, 256

W

Wasmaniella, 130
Willistoniella, 281
Willistonina, 389
Winnertzia, 126
Winthemia, 375
Wyeomyia, 108

X

Xanionotum, 239
Xanthracrona, 277
Xanthandrus, 254
Xanthina, 234
Xanthochlorus, 234
Xanthodexia, 357
Xanthogramma, 255
Xanthomelana, 369
Xanthomelanodes, 379
Xenochæta, 287
Xiphura, 91
Xylodiplosis, 129
Xylomyia, 162
Xylophagus, 162
Xylota, 258

Z

Zabrachia, 172
Zagonia, 298
Zacompsia, 278
Zodion, 263
Zygomyia, 138
Zygoneura, 139